MEDICO RESEARCH CHRONICLES
ISSN NO. 2394-3971
DOI No. 10.26838/MEDRECH.2021.8.4.544
Contents available at www.medrech.com

COMPARISON OF SENSORY AND MOTOR BLOCK OUTCOME OF FRACTIONATED VERSUS SINGLE BOLUS DOSE ADMINISTRATION OF HYPERBARIC BUPIVACAINE IN ELECTIVE CESAREAN SECTION

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ARTICLE INFO

Article History
Received: April 2021
Accepted: July 2021
Keywords: Caesarean section, Spinal anesthesia, Bupivacaine, Sensory block, Motor block.

ABSTRACT

ORIGINAL RESEARCH ARTICLE

Introduction: To achieve the best anesthetic outcome in pregnant women undergoing cesarean deliveries, spinal anaesthesia is the most popularly preferred method. The present study assessed the sensory and motor blockade outcome, following the administration of single bolus dose versus fractionated dose of bupivacaine as spinal anesthesia, in terms of the time of onset and regression, in cesarean section deliveries. **Methods:** With ethical approval from the corresponding authority and informed written consent from the patients, this study included 100 randomly selected, singleton, non-complicated pregnant women admitted in the Combined Military Hospital (CMH), Dhaka, during the period of July 2018 to June 2019, for elective LUCS. Patients were randomly divided into two equal groups- Group A and Group B, each comprised of 50 patients. Following the standard protocol to administer spinal anesthesia, Group A patients were given a single bolus dose of bupivacaine over 10 seconds and Group B patients were given fractionated dose of bupivacaine with two-third of the total calculated dose given initially, followed by one-third dose after 90 seconds. The age, height and physical status of the patients, the time of onset and regression of sensory and motor block were assessed and recorded. The post-operative pain was assessed with the linear visual analogue scale (VAS) every 30 min after surgery for the first 2 hours then hourly up to 6 hours and duration of analgesia was recorded. All the data has been analyzed with the help of IBM SPSS software (Statistical Package for Social Science) version-22. **Results**: The mean of the onset of sensory

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and motor block was faster in Group A than in group B, in case of sensory block onset it was 1.6 ± 0.5 min in Group A and 2.3± 0.8 min in Group B and in case of motor block onset it was 5.4 ± 1.1 min in Group A and 5.9± 1.2 min in Group B ($p>0.05$). The duration of sensory (Group A: 143.5 ± 23.7, Group B: 212.7 ± 38.6) and motor block (Group A: 118.5 ± 22.5, Group B: 175.2 ± 28.3 was significantly higher in group B than in group A, ($p<0.05$). Group A patients had significantly higher mean of the VAS score than Group B patients at each time point ($p<0.05$). The mean of the duration of analgesia was statistically significantly higher in Group B (235.1± 29.2) than in Group A (198.5±21.3) ($p<0.05$). **Conclusion:** This study concludes with the findings that, fractionated administration of bupivacaine in spinal anesthesia provides better aesthetic outcomes in terms of prolonged duration of sensory and motor block.

2021, www.medrech.com

I INTRODUCTION

Spinal anaesthesia is the most popularly preferred method of attaining anaesthesia for patients having lower abdomen and lower extremity surgical interventions. [1,2] Spinal anaesthesia is a rapid and reliable anaesthetic procedure, requiring for low dose to produce effective anaesthesia, thus, there is less chance of adversities, which makes it a safer choice for caesarean sections. [3] It also subsides the thromboembolic complications of general anesthesia. [4] For the onset of anesthesia effectively, spinal technique requires significantly lower amount local anesthetics than that of the epidural technique which ensures lower drug concentration in the mother and fetus, thereby reduces the chance of systemic toxicity. [5] Spinal anaesthesia results in a dense block and as it is injected directly into the CSF, where it acquires direct access to the nerve roots of the spinal cord resulting in rapid onset. [3,6] However, apposite dose adjustment is essential for the hemodynamic stability of the pregnant woman following the administration of spinal anesthesia. [7] Required dose to achieve the denervation depends on factors such as height, weight and anatomy of the spine of the patient. [8] Also, various other factors can impact the rapidity of onset as well as the depth of the sensory and motor blockade in patients, ranging from the type of needles to temperature and rate of infusion and even the posture of the patient. [9] The hemodynamic instability after infusion of spinal anesthesia is caused by the rapid sympathetic blockade, which can be reduced by the administration of the spinal anesthesia in fractionated dose rather than a bolus dose. With an initial administration of two-third of the total estimated dose followed by rest of the one-third with an interval of 90 seconds, showed to have provided dense block with greater haemodynamic consequences. [10] Moreover, several literatures have observed that, local anaesthetics when infused in fractions with a time interval, provides greater blockade outcome with prolonged duration of analgesia even after delivery, while no outcome difference in the condition of the neonates have been observed. [11–13] On the other hand, spinal anesthesia with unadjusted bolus dose showed to have resultant in undesired cervical dermatomal block considerably in higher proportion compared those who received adjusted dose which determines better safety for the patients. [14] On the above mentioned grounds, the present study assessed the sensory and motor blockade consequences, following the administration of

fixed bolus dose versus fractionated dose of bupivacaine as spinal anesthesia, in terms of the time of onset and regression, in cesarean section deliveries.

II METHODOLOGY

Study design and study sample: With a randomized control trial study design, this research work prospectively observed pregnant women undergone elective LSCS procedure, in Combined Military Hospital (CMH), Dhaka within a period of twelve months, from July 2018 to June 2019. After availing the ethical permission from the ethical review committee of the hospital and informed written consent of the patients, a total 100 non-complicated parturient were selected as per selection criteria of the study and randomly divided into two equal groups- group A and group B, where group A patients were given a single bolus dose of Bupivacaine and Group B patients received fractionated dose of Bupivacaine.

Spinal anesthesia procedure: Among both of the study groups, after establishing the intravenous access, monitoring procedures to observe NIBP, ECG and pulse oximeter (SpO_2) were instituted. Patients were infused with ranitidine, ondansetron and Ringer's lactate (RL) solution. Following the standard protocol to administer spinal anesthesia, Group A patients were given a single bolus dose of bupivacaine over 10 seconds, whereas, Group B patients were given fractionated dose of bupivacaine with two-third of the total calculated dose given initially followed by one-third dose after 90s. In both group of patients, injection bupivacaine 0.5% heavy was injected with a calculated dose of 0.06 mg/cm of the height of the patient.

Data collection: The age, height and physical status of the patients according to the American Society of Anesthesiologists (ASA) have been evaluated and recorded. The time of onset and regression of sensory and motor block were assessed and recorded. All the observations were documented in a preformed data sheet.

Assessment of sensory blockade: The duration of sensory blockade was defined as the interval from intrathecal administration of local anesthetic to S2 segment regression.

Assessment of motor blockade: The duration of motor blockade was defined as the time intervals from the onset of motor block to the time of achievement of modified Bromage scale zero (0).

Assessment of Pain: Post-operatively, pain was assessed using visual analogue scale (VAS). 0: No pain, 2–4: Mild pain, 5–7: Moderate pain, 8–10: Worst pain. Pain was assessed every 30 min post-operatively for the first 2 hours then hourly up to 6 hours.

Assessment of duration of analgesia: Duration of analgesia was calculated from the time of onset of sensory block at T10 till the patient first complained of pain post-operatively or when they demanded for rescue analgesic with the VAS of ≥4.

Statistical analysis: All the data has been analyzed with the help of IBM SPSS software (Statistical Package for Social Science) version-22. Frequency and percentage was calculated for quantitative data and mean and SD was calculated for qualitative data, such as age and maximum dermatome achieved was analyzed statistically using Chi-square test. Comparative analysis was carried out to observe the difference of findings between the groups where p value less than 0.05 considered as statistically significant.

III RESULTS

In this study, the mean age of the respondents was 25.9±4.4 years in Group A and 24.6±4.1 years in Group B. The mean of the height of the respondents was 160.32±9.5 cm and 161.95 ±9.8 cm in Group A and Group B respectively. The distribution of ASA physical status showed that, in Group A, 62.0% of the respondents had ASA I status compared to 56.0% in Group B. Respondents

with ASA II status was 38.0% in Group A compared to 44.0% in Group B. The differences of background characteristics were not statistically significant between the groups (p>0.05) (Table I).

Table I: Background characteristics of the study sample.

		Group A (n_1=50)	Group B (n_2=50)	p-value
Age (years)	**Mean ± SD**	25.9±4.4	24.6±4.1	0.641[a]
Height (cm)	**Mean ± SD**	160.32 ±9.5	161.95 ±9.8	0.654[a]
ASA status	**ASA I**	31(62.0%)	28(56.0%)	0.588[b]
	ASA II	19(38.0%)	22(44.0%)	

[a] p value reached from student's t test
[b] p value reached from chi-square test
Group A: Single bolus dose of bupivacaine
Group B: Fractionated dose of bupivacaine

According to this study observations, the mean time for the sensory block at T10 was faster in single bolus dose group (Group A, 1.6 ± 0.5 min) than fractionated dose group (Group B, 2.3± 0.8 min). In maximum cases, it took 1 to 3 min for the sensory block onset in both of the groups. The duration of sensory block was higher in group B than group A, with the mean regression time 143.5 ± 23.7 min in Group A and 212.7 ± 38.6 min in Group B. The difference in the mean of the duration of sensory regression was statistically significant among the groups (P < 0.05). The sensory regression time for highest of the proportion in Group A took 131-180 min (70.00% cases), in Group B, for the highest proportion of patients it took 181-230 min (54.00% cases) (Table II).

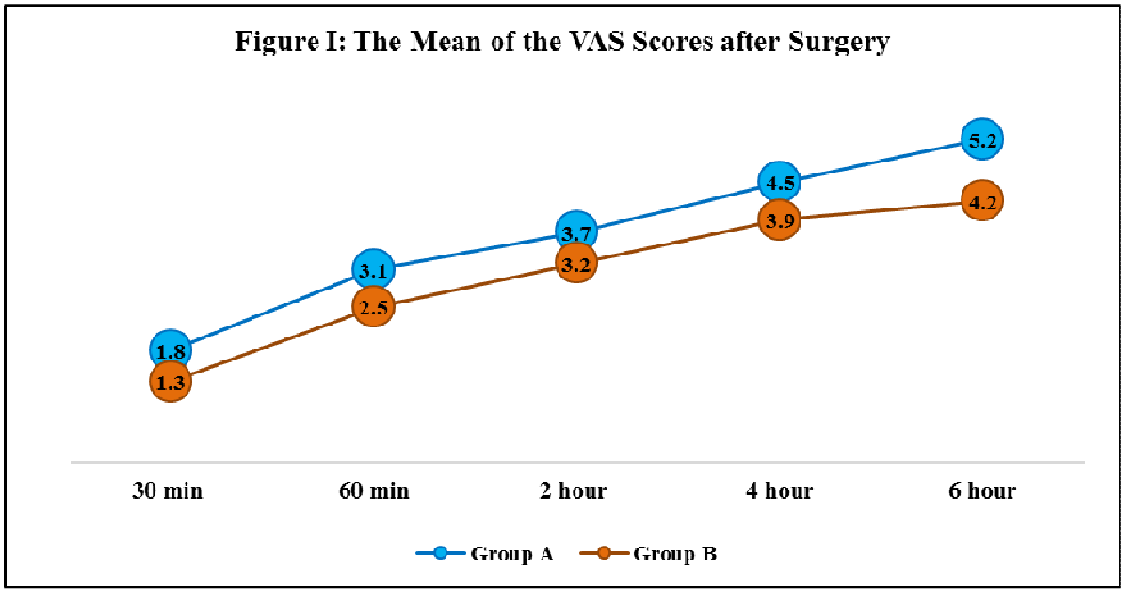
Table II: Onset and regression of sensory block.

	Group A (n_1=50)	Group B (n_2=50)	p value
Onset of sensory block (min)			
1-3	48(96.0%)	45(90.0%)	
4-5	2(4.0%)	5(10.0%)	
Mean ± SD	1.6 ± 0.5	2.3± 0.8	0.069[ns]
Regression of sensory block (min)			
80-130	12(24.0%)	4(8.0%)	
131-180	35(70.0%)	19(38.0%)	
181-230	3(6.0%)	27(54.0%)	
Mean ± SD	143.5 ± 23.7	212.7 ± 38.6	0.001[s]

p value reached from student's t test
Group A: Single bolus dose of bupivacaine
Group B: Fractionated dose of bupivacaine

Table III: Onset and regression of motor block.			
	Group A (n_1=50)	**Group B (n_2=50)**	**p value**
Onset of motor block (min)			
4-5	16(32.0%)	11(22.0%)	
6-7	34(68.0%)	39(78.0%)	
Mean ± SD	5.4 ± 1.1	5.9± 1.2	0.082^{ns}
Regression of motor block (min)			
80-130	38(76.0%)	13(26.0%)	
131-180	12(24.0%)	31(62.0%)	
181-230	0	6(12.0%)	
Mean ± SD	118.5 ± 22.5	175.2 ± 28.3	0.001^{s}
p value reached from student's t test Group A: Single bolus dose of bupivacaine Group B: Fractionated dose of bupivacaine			

In both of the groups, for more than half of the cases it took 6-7 min for the motor block onset. For the regression of motor block, in 76.00% cases in Group A it took 80-130 min, whereas, in Group B it took 131-180 min for 62.00% cases. The mean time of the onset of motor block was 5.4 ± 1.1 min in Group A and 5.9± 1.2 min in Group B patients, while the mean time of motor regression was 118.5 ± 22.5 min in Group A and 175.2 ± 28.3 min in Group B. The difference of mean time of motor onset was not statistically significant between the groups ($p > 0.05$), although it was statistically significant in case of motor regression time ($p < 0.05$) (Table III).



Comparison of postoperative visual analogue score (VAS) among the groups had showed that, at each time point, Group A patients had significantly higher mean of the VAS score than Group B patients ($p<0.05$) (Figure I).

Table IV: Duration of Analgesia Among the Groups (min).			
	Group A (n_1=50)	**Group B (n_2=50)**	**p value**
Mean ± SD	198.5 ± 21.3	235.1± 29.2	0.034
p value reached from student's t test Group A: Single bolus dose of bupivacaine Group B: Fractionated dose of bupivacaine			

The mean of the duration of analgesia among Group A and Group B was statistically significantly different which was higher among Group B that is among the group administered with fractionated dose of bupivacaine ($p<0.05$) (Table IV).

IV DISCUSSION

The study has observed that, among the single bolus dose group of infusing bupivacaine, compared to administration by fractionated dose group, there was no statistical difference between the groups in terms of age, height or physical status ($p>0.05$). The mean time for the sensory block was faster in single bolus dose group (1.6 ± 0.5 min) than fractionated dose group (2.3± 0.8 min) and the mean time of sensory regression was 143.5 ± 23.7 min in single bolus dose group and 212.7±38.6 min in the fractionated dose group. The mean difference of onset of sensory block was not statistically significant between the groups ($p>0.05$), but it was statistically significant in case of time of sensory regression ($p<0.05$). The mean time of the onset of motor block was 5.4 ±1.1 min in single bolus dose group and 5.9±1.2 min in fractionated dose group patients while the mean time of motor regression was 118.5±22.5 min in single bolus dose group and 175.2 ± 28.3 min in fractionated dose group. The difference mean in case of time of onset was not statistically significant between the groups ($p > 0.05$), although it was statistically significant in case of motor regression time ($p<0.05$). Assessment of post-operative pain with visual analogue score (VAS) among the groups had revealed that, significantly higher mean of the VAS score among the patients in bolus dose group than the patients in fractionated dose group. ($p<0.05$). With the same objective as our study, some other studies have also found fractionated dose to be more beneficial regarding the duration of sensory and motor block, which are discussed as followed. In the study by Khare et al., they aimed to compare the bolus dose versus fractionated dose of injection bupivacaine heavy (0.5%) in spinal anaesthesia, in patients with cesarean section with non-significant difference of the demographic profile. They found that, the mean time of onset of sensory block was 1.4 ± 0.51 and 1.29 ± 0.5 min ($p>0.05$) and mean time of regression of sensory block was 160 ± 29 and 235 ± 42 min ($p<0.001$) in the bolus versus fractionated dose group respectively. In case of motor block they found, 5.77 ± 1.13 and 4.67 ± 1.1 min of mean time of onset and 144 ± 25 and 203 ± 42 min of mean time of regression (both strongly significant, $p<0.001$) in the bolus versus fractionated dose group respectively. [15] In the study by Badheka et al., the mean of the age was 26.63±3.2 years and 25.26±3.1 years and the mean of the height was 152.87±4.31 cm and 151.9±5.31 cm in the bolus dose and fractionated dose group respectively. In their study, they found the mean of the onset of sensory block was 1.5±0.51 min compared to 1.39±0.5 min in the bolus versus fractionated dose group ($p>0.05$) whereas, the mean of the sensory block regression time was 161±29 min versus 236±42 min respectively ($p<0.001$) in case of motor block, they found that the mean of the time of onset was 5.87±1.13 min and 4.77 ±1.1 min in the bolus versus fractionated dose group ($p<0.001$) and the mean of the

motor block time was 145±25 min versus 204±42 min respectively (p<0.001).[11] In the study by Derakhshan et al., the time of onset of sensory block was longer in fractionated dose group than bolus dose group, where, the difference was not significant. However, the motor blockage onset time was significantly shorter in fractionated dose group than bolus dose group (p<0.05). The sensory blockage duration was statistically significantly longer in the fractionated dose group than the bolus dose group (p<0.05), but the difference of motor block duration was not significant in between the groups (p>0.05). They observed that, the level of highest sensory block was significantly higher in bolus dose group than the fractionated dose group (p<0.05). [16] In the study by Srivastava et al., they have observed that, in the bolus dose group, the sensory block onset was quicker than fractionated dose group (107.33±13.50 second and 111.67±14.46 second respectively, p>0.05). On the other hand, the motor onset was faster in fractionated dose group than the bolus dose group B (446.00±56.97 second and 438.00±47.30 second respectively, p<0.05). The duration of sensory block (192.83±13.18 min) was statistically significantly higher in fractionated dose group than bolus dose group (177.83±17.20) (p<0.001). The duration of motor block was also significantly higher in fractionated dose group (149.00±11.85 min) compared to bolus dose group (141.83±11.78 min) (p<0.05) [8] Similarly, Fahmy et al., observed the anaesthetic outcome of same dose of bolus compared to fractionated administration of Bupivacaine. They have reported that, fractionated dose of Bupivacaine prolonged the duration of sensory and motor blockade. [17] In the study by Nakul Srivastava, contrary to our findings, they have found that, the mean VAS score at 5 hours found to be significantly higher among fractionated dose group compared to that of the bolus dose group. [8] Although, in the study by Khare et al they found that, the duration of analgesia was prolonged in fractionated group when compared that with bolus group patients. [15] This study also observed that the mean of the duration of analgesia was statistically significantly higher in Group B (235.1± 29.2) than in Group A (198.5 ± 21.3) (p<0.05) which is also simultaneous with other study findings. [18]

V CONCLUSION

The longer duration of anaesthesia availed from the minimum dose of anesthetic agent provides with lesser exposure to unnecessary drug which are of great concern, especially when it regards with pregnancy termination, as both the mother and the baby get exposed to the drug. This study concludes with the findings that, the fractionated dose of Bupivacaine provides longer sensory and motor block with prolonged duration of analgesia results than that of the single bolus dose with the same volume of the drug.

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