How to Cite:
Mohan, S. S., Narendren, G., & Calingarayar, D. F. J. (2022). Analgesia with bupivacaine under subarachnoid block in patients undergoing lower abdominal surgeries. *International Journal of Health Sciences*, *6*(S9), 1226–1235. https://doi.org/10.53730/ijhs.v6nS9.12481

Analgesia with bupivacaine under subarachnoid block in patients undergoing lower abdominal surgeries

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***Abstract*---**Background and Aim: To study and compare the hemodynamic stability and duration of analgesia in spinal anaesthesia among bolus versus lower fractional doses of bupivacaine in the arachnoid block for the patients undergoing lower abdominal surgeries specifically urologic, pelvic, and lower limb surgeries. Methods: Interventional Randomized Comparative case-control study done among 70 study participants to compare analgesia with bupivacaine under subarachnoid block in patients undergoing lower abdominal surgeries. Results: To sum up, we found that the time for onset of the sensory block with a fractionated dose of bupivacaine in spinal anesthesia was significantly lesser than the time taken with a bolus dose and took a significantly longer time to regress. Conclusion: We found that patients who received a fractionated dose of bupivacaine had a faster onset of motor blockade compared with those who received a bolus dose and that block regression was slower in them.

***Keywords*---**Analgesia, Bupivacaine, Lower limb surgeries, Motor block, Sensory block, Spinal anesthesia

Introduction

Spinal anaesthesia is the subarachnoid form of regional anaesthesia involving the injection of a local anesthetic into the subarachnoid space, usually through a fine needle. It offers many advantages over general anaesthesia including reduced

stress response and improved postoperative pain relief. Spinal lignocaine which was commonly used earlier has been withdrawn because of its shorter duration of action and transient neurological symptoms.[1] Spinal bupivacaine is the most commonly used anaesthe agent in Spinal anaesthesia during lower abdominal and lower limb surgeries but since it induces profound motor blockade of longer duration and it delays postoperative mobilization and early discharge, is usually not used in daycare surgeries.[2]

Various previous studies have concluded that a fractional dose of bupivacaine in spinal anesthesia has more effective sensory and motor blocks when compared to a bolus dose.[3-4] Also sometimes bolus dose of bupivacaine in SA causes more hypotension while a fractionated dose of bupivacaine, in which two-thirds of the total calculated dose is given is initially followed by a one-third dose after a time gap of 90 seconds, achieves adequate SA and provides a dense block with hemodynamic stability.[5-6]

Therefore, we propose to evaluate the effectiveness of fractional dose of bupivacaine versus bolus dose in patients undergoing elective lower abdominal surgeries specifically urologic, pelvic and lower limb surgeries. With the above background the aim of the study is to compare the hemodynamic stability and duration of analgesia in spinal anaesthesia among bolus dose versus fractional dose of bupivacaine in the subarachnoid block for patients undergoing lower abdominal surgeries specifically urologic, pelvic, and lower limb surgeries.

Method

Study area- The study was conducted in the Department of Anaesthesiology, after obtaining approval from the institutional review board and institutional ethics committee, A medical college hospital.

Study subjects- 70 patients (35 in each group) of the American Society of Anesthesiologists physical status I – II, age from 18 to 60 years, height from 140 to 180 cm were studied.

Study design – Prospective and Interventional Randomized Comparative Study.
Study period – November 2018 to 31st March 2020
Sample size- Comparison of fractionated dose versus bolus dose injection in spinal anesthesia for patients undergoing elective cesarean section: A randomized, double-blind study was observed by Jigisha Prahaladray Badheka, et al.

The study observed that the duration of analgesia was longer in Group F (273.83 ± 20.62 min) compared to Group B (231.5 ± 31.87 min). Also, five patients (16.66%) in Group F and 14 patients (46.66%) in Group B required vasopressor. Taking these values as a reference, the minimum required sample size with 80% power of study and 5% level of significance is 34 patients in each study group. So total sample size taken is 70 (35 patients per group).

Inclusion Criteria: Consenting adult patients of either sex who are scheduled to undergo elective lower limb and lower abdomen surgery with Age (18-60 years), ASA 1 or 2, Body Mass Index between 18 to 30 kg/m2, Height from 140 to 180 cm

Exclusion criteria: Patient refusal, Patients with risk of gastric aspiration (Morbid Obesity, Diabetes mellitus, Gastroesophageal reflux disease), Patients with local skin infection, Allergy to amide local anaesthetic, Weight < 50kg or > 110kg, Coagulopathy, History of substance abuse, Mental dysfunction, Contraindication to spinal anaesthesia.

Statistical analysis: Quantitative variables are compared using the Unpaired t-test/Mann-Whitney Test (when the data sets were not normally distributed) between the two groups.

1. Qualitative variables are compared using the Chi-Square test /Fisher's exact test.
   A p-value of <0.05 was considered statistically significant.

Results

Group B: The patients received a single bolus dose of bupivacaine over 10 seconds at a rate of 0.2 ml/s.
Group F: The patients received a fractionated dose of bupivacaine with two-thirds of the total calculated dose given initially followed by one-third dose after 90 seconds at a rate of 0.2ml/s.

The Mean age of the patients was comparable in both the groups and there was no statistical difference between the groups. Both the groups were comparable in sex distribution with no statistically significant difference (p=0.734) (using Fisher Exact test). There was no significant difference between BMI, weight, and height of the patients between the groups. (done using student's t-test).

Both the groups were compared pre-operatively for baseline vitals like pulse rate (bpm), Systolic Blood Pressure (mmHg), and Diastolic Blood Pressure (mmHg). No significant difference was seen in the distribution of baseline vitals between Group F and Group B.

The onset, peak, and regression of sensory block were not normally distributed, thus Mann Whitney test was used for comparison. The mean time for onset of sensory block in Group B was 1.73 minutes while in Group F was 1.26 minutes. The peak sensory block was achieved in 5.61 minutes in Group B while it took 6.14 minutes in Group F. The mean time for regression of sensory block in Group B was 158.77 minutes and in Group F was 237 minutes. In Group F, the time for onset of sensory block was significantly lower and the time for regression of sensory block was significantly higher as compared to GroupB while there was no comparable difference in time to achieve peak effect in both the groups.

The onset and regression of motor block were not normally distributed, thus Mann Whitney test was used for comparison. The mean time for onset of motor block in Group B was 5.87 minutes while in Group F was 4.69 minutes. The

mean time for regression of sensory block in Group B was 149.54 minutes and in Group F was 198.43 minutes. The time for onset of motor block in group F was significantly lower and the time for regression of motor block was significantly higher as compared to Group B.

No significant difference was seen in VAS scoring at 30 minutes and 4 hours between groups B and F (p- >0.05). A significant difference was seen in VAS scoring at 60 minutes, 90 minutes, 2 hours, and 3 hours between groups B and F (p- <0.05).

Discussion

In our study, we aimed to compare fractionated dose versus bolus dose in spinal anesthesia for hemodynamic stability and duration of analgesia by assessing the duration of motor and sensory block in patients undergoing elective lower abdominal surgeries. In another study, The age distribution in our study was comparable between the two groups (p>0.05). The mean age of patients in the bolus group was 40 years and in the fractionated group was 47 years. The study groups had a comparable gender distribution also. The majority of patients in both groups were males (83% and 89%). Administration of 0.75% isobaric ropivacaine intrathecally was found to have shorter duration of motor blockade and similar duration of analgesia as compared to bupivacaine with hemodynamic stability and without significant side effects.[7]

Patients in the bolus group had a mean BMI of 24.94 and those in the fractionated group had a mean BMI of 23.71. In our study, the baseline hemodynamic parameters between the two groups were comparable (p>0.05). Following intrathecal injection, the heart rate, systolic blood pressure, and diastolic blood pressure were observed at 1, 5, 15, 30, 60, and 90 minutes, then immediate postoperative period and 30, 60, 120, and 180 minutes postoperatively.

We have concluded that in our study the patients of both groups were hemodynamically stable since we preloaded all patients with adequate intravenous fluids at 15ml/kg before the procedure due to which there was no fall in blood pressure after the procedure and no need for vasopressors in the study participants. In our study, the meantime for sensory block onset in fractionated dose group was 1.26 minutes whereas the bolus dose group was 1.73 minutes. Therefore, we concluded that fractionated dose of bupivacaine significantly reduced the time of onset of the sensory block as compared to the bolus dose (p<0.0001). However, the meantime for peak action was 6.14 minutes in the fractionated group as compared to the bolus group in which the meantime for peak action was 5.61 minutes, though the difference in time to achieve peak action was insignificant (p>0.05). The mean time for regression in the fractionated group was 237 minutes whereas it was 158.77 minutes in the bolus group, which was significantly longer (p<0.0001).

It was noted, that there was a significant difference in the motor block onset and regression between the two groups as well. The mean time of onset of motor block in the fractionated group was faster at 4.69 minutes while in the bolus group was

5.87 minutes (p<0.0001). The mean time for regression of motor block in the fractionated group was 198.43 minutes, longer than the bolus group where it was 149.54 minutes (p<0.0001). Ina study done by Badeka, Fractionated dose of SA provides greater haemodynamic stability and longer duration of analgesia compared to bolus dose .[8]

In our study, the VAS scores were noted at 30, 60, 90 minutes, and at 2hrs, 3hrs, and 4 hrs and we found that the VAS scores were comparable at 30 minutes and 4 hrs and were significant at 60 minutes, 90 minutes, 2hrs and 3hrs where there was a significant statistical difference between group B and group F. The time to the first analgesic requirement was early in group B (60.83 ± 3.05) as compared to group F (90.91 ± 5.82). This is because group F provided prolonged analgesia and hence the rescue analgesia was required in the latter as compared to that of group B.

Conclusion

To sum up, we found that the time for onset of the sensory block with a fractionated dose of bupivacaine in spinal anesthesia was significantly less than the time taken with a bolus dose and took a significantly longer time to regress. We found that patients who received a fractionated dose of bupivacaine had a faster onset of motor blockade compared with those who received a bolus dose and that block regression was slower in them. We also found that there was no statistically significant variation in the hemodynamic stability between patients in both groups. We also found that the patients who received fractionated doses of bupivacaine had better post-operative pain relief and required less analgesia as compared with those who received bolus doses. The study is done in a small group of people in a small set up and hence more data should be collected to find the overall effect of the study.

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Tables and Figures

(Table 1:-Comparison of age (years) between Group B and Group F (Original).)

Age(years)	B (n=35)	F (n=35)	Total	Test performed
18-20	4 (11.43%)	2 (5.71%)	6 (8.57%)	Chi-square test,7.006
21-30	11 (31.43%)	5 (14.29%)	16 (22.86%)	
31-40	4 (11.43%)	5 (14.29%)	9 (12.86%)	
41-50	5 (14.29%)	8 (22.86%)	13 (18.57%)	
51-60	8 (22.86%)	6 (17.14%)	14 (20%)	
>60	3 (8.57%)	9 (25.71%)	12 (17.14%)	
Mean ± SD	39.97 ± 16.01	46.89 ± 15.78	43.43 ± 16.16	Mann Whitney test;464
Median(IQR)	35(25.5-54.5)	48(35.5-60.5)	46(29-58.75)	
Range	18-68	18-75	18-75	

Table 2:-Comparison of systolic blood pressure(mmHg) between Group B and Group F.
(Original)

Systolic blood pressure(mmHg)	B (n=35)	F (n=35)	Total	P value	Test performed
Pre-operative					
Mean ± SD	126.83 ± 11.36	130.29 ± 7.37	128.56 ± 9.66	0.243	Mann Whitney test;513.5
Median(IQR)	125(121.5-137.5)	130(123.5-138)	127.5(123-138)		
Range	105-151	118-141	105-151		
After 1-minute post intrathecal injection					
Mean ± SD	125.66 ± 9.62	129.94 ± 7.36	127.8 ± 8.77	0.073	Mann Whitney test;460.5
Median (IQR)	124(119.5-135.5)	129(123-136)	128(121-136)		

Range	110-141	119-142	110-142		
After 5 minutes post intrathecal injection					
Mean ± SD	125.66 ± 9.62	128.11 ± 6.99	126.89 ± 8.44	0.383	Mann Whitney test;538.5
Median(IQR)	124(119.5-135.5)	128(121-134)	127(121-134.75)		
Range	110-141	117-140	110-141		
After 15 minutes post intrathecal injection					
Mean ± SD	124.6 ± 10.07	127.86 ± 7.04	126.23 ± 8.78	0.237	Mann Whitney test;512
Median(IQR)	121(119-134.5)	126(122-134.5)	126(119-134.75)		
Range	108-142	116-141	108-142		
After 30 minutes post intrathecal injection					
Mean ± SD	123.97 ± 10.31	127.4 ± 8.12	125.69 ± 9.37	0.191	Mann Whitney test;501.5
Median(IQR)	121(118-134.5)	126(120-135)	124.5(118-135)		
Range	106-139	116-143	106-143		
After 1-hour post intrathecal injection					
Mean ± SD	123.74 ± 10.31	127 ± 7.42	125.37 ± 9.06	0.244	Mann Whitney test;513.5
Median(IQR)	121(118-135)	126(121-134.5)	124(118.25-135)		
Range	107-141	116-140	107-141		
After 1-hour 30-minute spot intrathecal injection					
Mean ± SD	124.06 ± 10.27	127.17 ± 8	125.61 ± 9.27	0.261	Mann Whitney test;517
Median(IQR)	122(118.5-135)	128(119-135)	125(119-135)		
Range	108-144	114-138	108-144		
Immediate post-operative					
Mean ± SD	126.71 ± 12.82	126.8 ± 7.63	126.76 ± 10.47		Mann Whitney

Median(IQR)	124(116.5-139)	128(118.5-132.5)	126(118.25-134.75)	0.883	test;600
Range	105-151	116-140	105-151		
Post-operative 30 minutes					
Mean ± SD	125.17 ± 9.78	129.11 ± 7.47	127.14 ± 8.86	0.056	Mann Whitney test;450.5
Median(IQR)	121(117-136)	129(123-136.5)	126(121-136)		
Range	110-141	118-141	110-141		
Post-operative 1 hour					
Mean ± SD	124.83 ± 10.07	128.83 ± 7.23	126.83 ± 8.93	0.093	Mann Whitney test;470
Median(IQR)	122(118.5-135.5)	128(121-136)	126.5(121-136)		
Range	107-141	119-142	107-142		
Post-operative 2 hours					
Mean ± SD	124.6 ± 10.37	127.09 ± 6.94	125.84 ± 8.85	0.276	Mann Whitney test;520
Median(IQR)	121(118.5-134.5)	127(121-134)	124.5(119-134)		
Range	108-142	117-140	108-142		
Post-operative 3 hours					
Mean ± SD	124.2 ± 10.41	126.97 ± 7.05	125.59 ± 8.94	0.278	Mann Whitney test;520.5
Median(IQR)	121(118-134)	126(122-133.5)	124(118.25-134)		
Range	106-139	116-141	106-141		

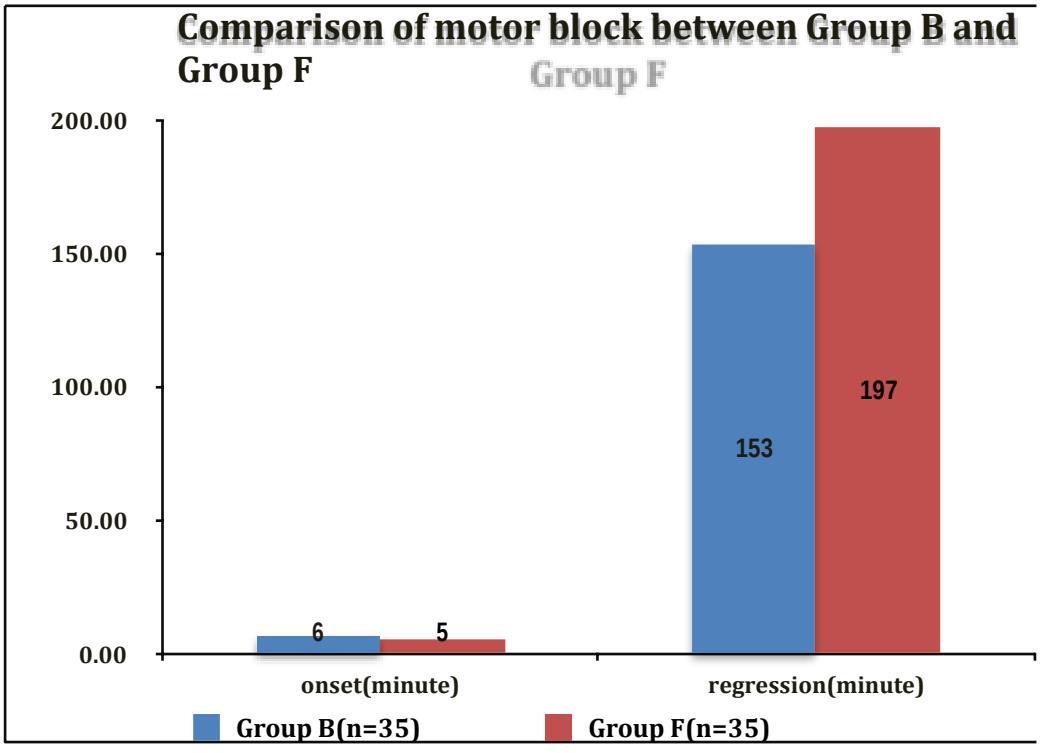

Figure 1:-Comparison of the motor blocks between Group B and Group F.(non-parametric variables) (Original)