

# Effect of Site of Injection on Spread of Spinal Anaesthesia with Hyperbaric Bupivacaine

M. A KARIM<sup>1</sup>, DEBASISH BANIK<sup>2\*</sup>, QUMRUL HUDA<sup>2</sup>, ABDUL HYE<sup>2</sup>,  
DEBABRATA BANIK<sup>2</sup>, FERENZA BEGUM<sup>3</sup>

## Abstract:

*Spinal Anaesthesia during caesarean section is popular world wide. The aim of the study was to explore the efficacy of spinal Anaesthesia with hyperbaric bupivacaine at different intervertebral space in lower uterine caesarean section.*

*Ninety unpremeditated patients (20-40 years) undergoing caesarean section were allocated randomly to receive 0.5% hyperbaric bupivacaine 2ml at the site of L2-3, L3-4 and L4-5 intervertebral space. Spinal injection was performed to all patients with a 25-gauge Quincke spinal needle. The onset time of analgesia at T10 and T6 was significantly faster and the level of analgesia at 5 and 10 min was significantly higher after injection at L2-3. But the maximum height (T4) of analgesia at 15 and 20 min after injection and the number of episodes of hypotension were not significantly different among the three groups.*

*So we can conclude that onset of Analgesia is altered by the site of injection, but the overall analgesia level achieved remain unchanged.*

**Key words:** *Spinal anaesthesia, hyperbaric bupivacaine, site of injection, spread of anaesthesia.*

## Introduction:

Spinal anaesthesia has its own unique place in modern anaesthetic practice. It also has gained popularity for obstetrics cases. Regional anaesthesia is associated with less maternal morbidity and mortality than general anaesthesia which may be largely due to reduced failed intubations and pulmonary aspiration. Spinal anaesthesia allow a mother to remain awake and experience the birth of her child. One important advantage like other regional technique is patient ability to participate in the whole procedure realizing what is going on and even to co-operate when necessary. It helps patient to get rid of one of the biggest concern of fear of not waking up after the surgery.

The profile of spinal anaesthesia after subarachnoid administration of hyperbaric solutions changes with increasing ages<sup>1</sup>. Pregnancy is known to cause higher cephalad spread of analgesia<sup>2,3</sup>. Age and level of anaesthesia appear to be the main factors associated with the development of hypotension during spinal anaesthesia<sup>4</sup>. The degree of arterial hypotension

correlate well with the level of sympathetic block which is 2-4 segment higher than level of anaesthesia. The predictability of the extent and duration of sensory block has been noted by many authors. Factors thought to influence intrathecal spread are total dose<sup>6</sup>, baricity<sup>7-9</sup>, volume and the patient position have been studied. The importance of the site of injection still remained controversial.

The purpose of our study was to compare the effects of 2 ml ( same volume) of 0.5% hyperbaric bupivacaine (same dose) at the site of L 2-3, L 3-4 and L 4-5 intervertebral space in lower uterine caesarean section in sitting position.

We hypothesized that induction of spinal anaesthesia at L2-3 intervertebral space produce faster spread of anaesthesia and analgesia

## Materials & Methods:

Ninety ASA (American society of Anaesthesiologist) physical status I & II patients scheduled for elective Caesarean section gave their written informed consent and were included in the study were randomly allocated

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1. Department of Anaesthesiology, S.S.M.C.& Mitford Hospital Dhaka.
  2. Department of Anaesthesia, Analgesia & Intensive Care Medicine. BSMMU, Dhaka.
  3. Department of Gynae & Obstetrics, BSMMU, Dhaka.

into three groups, 30 patients in each group. Patients were excluded if they had significant cardio-vascular or neurological diseases or any contraindication for spinal anaesthesia.

Group-I : Lumbar 2-3 intervertebral spaces.

Group-II : Lumbar 3-4 intervertebral spaces.

Group-III : Lumbar 4-5 intervertebral spaces.

None of the patient was premedicated. No sedatives or anticholinergic drugs were administered before spinal anaesthesia. On arrival of the patient in the operation room initial values of heart rate, blood pressure (systolic, diastolic, mean arterial pressure) and peripheral oxygen saturation were recorded. A peripheral intravenous cannula was inserted and 15 ml/kg Hartmann's solution was infused rapidly before subarachnoid block. The appropriate lumbar vertebra was counted from both the cranial and caudal directions and palpation of the iliac crest was performed to confirm the position of the 4<sup>th</sup> lumbar vertebra. After all aseptic precaution spinal anaesthesia was induced in all patients with a 25-gauge Quincke spinal needle via a midline approach at sitting position. When a free flow of clear cerebrospinal fluid was obtained 2 ml of 0.5% hyperbaric bupivacaine was injected over 20-30 seconds without barbotage. The needle was inserted with its bevel parallel to the dural fibers and then rotated 90° to direct the bevel cephalad. Immediately after sub-arachnoid block the patients were gently turned to the supine position with tilt to the left with the wedge under right buttock. No attempt was made to influence the spread of spinal anaesthesia by tilting the operating table. Completion of the injection was taken as zero time. The level of analgesia was assessed bilaterally in the anterior axillary line by pinprick method using a 25-gauge needle. Thoracics T6 (Thoracics) is the level of anaesthesia considered adequate to provide analgesia for caesarean section. Motor block of the lower limbs was assessed bilaterally using the modified Bromage scale, 0-Able to raise the extended leg, 1-Inability to flex the knee, 2-Inability to flex the ankle. "0"no block and "3" denotes complete block. Assessment was made at 1min interval for first 10 min and at 2 min interval there after up to 20 min.

Heart rate, blood pressure and oxygen saturation was measured just after block and at 5-min interval. If systolic arterial blood pressure decreased more than 20% from pre-anaesthetic value ephedrine was given

intravenously as required and the amount was recorded. Oxygen therapy was given when needed. Any other side effects (e.g. nausea, vomiting, shivering, headache, chest discomfort etc.) was observed. The time from "0" hour to use of 1<sup>st</sup> rescue analgesic dose was recorded.

The pain intensity was measured by using Verbal Rating Score (VRS) as follows:

- "0" for no pain.
- "1" for mild pain (pain on movement and/or on respiration)
- "2" for moderate pain ( tolerable pain on rest)
- "3" for severe pain (intolerable pain on rest)

1<sup>st</sup> rescue analgesic dose was used when patient can move the limb (VRS-1). All data was compiled and statistically analyzed by ANOVA and Chi-square test with 95% confidence limit. A value of  $P < 0.05$  was considered significant.

#### Results:

There were no statistically significant differences among the three groups with regard to patients characteristics, obstetrics details or foetal outcome (Table-1) ( $P > 0.05$ ).

The changes in heart rate following block among the three group from zero to 15 minutes ( $p < 0.05$ ) were not significant. However at 30 minutes and at 1 hour period the heart rate of group-I was significantly higher compared to other two groups ( $P = 0.0002$  and  $0.001$  respectively) although at 2 hour the rate was not found to vary significantly among the groups ( $p > 0.05$ )

The changes in systolic BP during the 2 hours period following block was found at its height ( $122.6 \pm \text{mmHg}$ ) in group-I in comparison to the group-II and group-III ( $116.3 \pm 13.0$  and  $114.6 \pm 9.2$  mmHg respectively) and the difference was statistically significant ( $p > 0.05$ ). However, at 5, 15, 30 minutes and 1 hour and at 2 hours intervals the data did not reveal any significant different among the groups.

The changes in Oxygen saturation ( $\text{SPO}_2$ ) during the 1<sup>st</sup> 5 minutes was found to be better in group-I compared to group-II and III ( $p < 0.05$ ). There after it became nearly equal to other group at 15 minutes and onwards no significant difference among the groups. The time required to spread of analgesia to T10 and T6 (Table-II) was found significantly faster in group-I than those in group-II and group-III ( $p < 0.001$ )

In Fig.-1 shows the dermatome level of spread of analgesia at different time intervals. The level attained at 5 minutes in group- I was between T6 and T5, while at the same time in group-II and group-III was between T7 and T6. The level of analgesia reached at 10 minutes in group-I was between T5 and T4, while that in group-II and III was between T6 and T5. The difference between group-I and other groups at 5 and 10 minutes

after the blocks were revealed statistically significant ( $p < 0.001$  and  $p < 0.05$  respectively).

The onset of motor block was found to be significantly different among three groups ( $p < 0.05$ ). The onset of motor block was faster in group-I ( $1.50 \pm 0.51$  minutes) compared to group-II and group-III ( $p < 0.001$ ) indicating that the higher the interspaces chosen faster will be the motor block (Table-III).

**Table-I**  
]Characteristics of the study population:

	Group 1	Group 2	Group 3	P-Value
N	30	30	30	NS
Age (yr)	27.25±.63	28.15±.58	27.5±.61	NS
Weight (kg)	62.9±1.12	63.15 ±.15	62.3±1.1	NS
Height (cm)	152.6±.6	152.9±.9	152.8±.7	NS
Gestation (weeks)	40.3±1.3	40.8±1.4	39.9±1.2	NS
Apgar Score at				
1(min)	8.6 ±1.4	8.4±1.2	8.3±1.3	NS
2 (min)	9.1±0.6	9.2±0.9	9.3±0.8	NS
Time between spinal anaesthesia and onset of surgery	8 ± 1	9 ±1.5	7.8±2	NS
Duration of surgery; (min)	40±10	49±11	39.848±17	NS

Data are given as mean ±SD. No differences were found among the groups by using ANOVA test.

**Table-II**  
Comparison of time required to spread of analgesia (minutes):

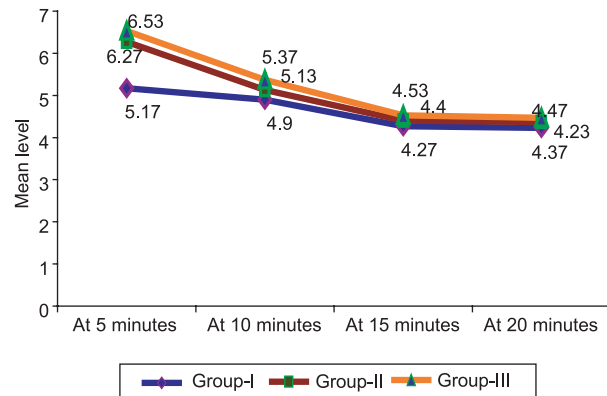
Level of Analgesia	Group-I(n = 30)	Group-II(n = 30)	Group-III(n = 30)	
T10	1.0 ± 0.0	2.7 ± 0.47	3.1 ± 0.40	<0.001 <sup>S</sup>
T6	2.27 ± 0.78	5.3 ± 2.02	5.50 ± 1.38	<0.001 <sup>S</sup>
T4 (Maximum)	10.03 ± 1.19	10.60 ± 3.18	10.97 ± 5.52	.086

The variables are presented as mean ± SD; S = Significant.

**Table-III**  
Comparison of motor block(min):

	Group I(Minutes)	Group II (Minutes)	Group III (Minutes)	
Onset of motor block scale-1	1.50 ± 0.51	1.77 ± 0.68	2.37 ± 0.67	<0.001 <sup>S</sup>
Maximum degree of motor block scale-3	2.97 ± 0.18	3.00 ± 0.01	2.93 ± 0.25	0.364
Time required to attain maximum height of block.	12.33 ± 3.64	11.97 ± 2.19	11.53 ± 1.17	0.479

The variables are presented as mean ± SD; S = Significant.



**Fig.-1:** Comparison of the level of analgesia at different time

### Discussion:

The initial cephalad spread of 0.5% hyperbaric bupivacaine was faster after subarachnoid block at the site of L2-3 interspace as demonstrated by the difference at T10 and T6 at 5 and 10 min after induction and onset of time of motor blockade. Thereafter, it appeared that the spread of the local anaesthetic solution similar to the 3 groups as demonstrated by the non-significant differences in the levels of analgesia at 15 and 20 min, the quality of motor block and the maximum height and range of analgesia obtained. It is consistent with the mean time to produce the maximum upper segmental level of analgesia which was 15 min<sup>14,15</sup>.

It appeared from this study that the site (L2-3, L3-4 and L4-5) of the lumbar interspace chosen for spinal injection was of little importance in relation to the height of the block produced. A possible explanation for these findings is the site of the intervertebral space chosen for block in relation to the maximum height of the lumbar curvature at L3. Spinal injection at the site of interspace L2-3 deposit the hyperbaric anesthetic solution on the cranial side of the maximum height of the lumbar curvature at L3, where it spreads cephalad under the influence of gravity.

The study was based on earlier observations which showed that a hyperbaric local anaesthetics solution produced bimodal spread when the patient was turned supine horizontal position after spinal injection at site of L3-4. In this situation the solution is under the influence of gravity and migrates preferentially to the low levels of subarachnoid that is below L3 in the lumbosacral concavity or above L3 in the thoracic concavity<sup>16</sup>. However, a hyperbaric solution injection

at L4-5 must first spread cephalad by bulk displacement of CSF and diffusion before gravity induces further cephalad spread. The mechanism whereby the spreads of local anaesthetic solution at L4-5 “caught up” with that injection at L3-4 is not known. However, this catching up may explain the fact that the number of episodes of hypotension and the mean dose of ephedrine required to treat hypotension did not differ significantly among the groups.

In the study by Russell and Holmquist<sup>15</sup> the injection of hyperbaric plain 0.5% bupivacaine 2.5 ml with the patient in the lateral position produced maximum height of analgesia greater than in the present study. With blocks rising to the cervical dermatomes in 25% of patients. In the present study no patient developed objective loss of pinprick analgesia above the T3 dermatome. This study differs from that of Russell in two ways; Dose and volume and the position of the patient when the hyperbaric local anaesthetic solution was injected. In this study both are probably the significant factor. The slow injection of 2ml 0.5% hyperbaric bupivacaine with the patient in the sitting rather than the 2.5 ml and lateral position may limit cephalad spread of local anaesthetics. So reducing the incidence of block reaching the cervical dermatomes. Certainly, spinal injection with the patient in the sitting rather than the lateral position appears to limit the rate of cephalad spread of the hyperbaric anaesthetic solution. At 5 min after injection the median level of block in the present study was T5 (L2-3), T6 (L3-4) and T7 (L4-5) compared with T3 in the study by Russell<sup>15</sup>. There was no significant difference of mean time of duration of analgesia among the three groups. Increasing the volume administered into the subarachnoid space specially in a hyperbaric solution, resulted in significantly greater cephalad spread and increase the duration of block<sup>16,17</sup>.

Episodes of discomfort were recorded in three patients in group-I, three patients in group-II, two patients in group-III. No patients in any group complained of discomfort at incision from skin to the uterus. All occurred after delivery, associated with roughly moping or associated with suturing of the uterus or abdominal wall and was relieved after few minutes. Discomfort was not associated with lower levels of block. The range of block in patients who experience discomfort were T4-5 in group L2-3, T4-5 in group L3-4 and T4-6 in group L4-5.

Oxygen saturation was not significantly different among three groups. It thus appeared that adequate and not excessive extent of analgesia was achieved. Oxygen saturation was statistically significant at 5 min after block but the mean values of oxygen saturation at 5 min were 97.9% in group-I, 97.5% in group-II and 97.6% group-III i.e. they were almost equal and normal. Oxygen saturation was no significantly different up to 1 hour. One patient developed restlessness which may be psychological because she had delivered her 3<sup>rd</sup> female child.

### Conclusion:

The choice of the site of lumbar inter vertebral space influenced the rate of onset of analgesia but not the dermatomal level of analgesia achieved.

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