A RANDOMISED CLINICAL TRIAL FOR COMPARISON OF DIFFERENT VOLUMES OF 0.5% BUPIVACAINE (HYPERBARIC) IN SUBARACHNOID BLOCK WITH RESPECT TO LEVEL AND DURATION OF SENSORY AND MOTOR BLOCKADE

Ghazia Hina[1], Sherry Mathews[2], Nuthula Satyanarayana[3]

[1]Resident, Department of Anaesthesiology, Shadan Institute of Medical Sciences, Hyderabad.
[2]Associate Professor, Department of Anaesthesiology, Shadan Institute of Medical Sciences, Hyderabad.
[3]Professor and HOD, Department of Anaesthesiology, Shadan Institute of Medical Sciences, Hyderabad.

ABSTRACT

AIMS AND OBJECTIVES

The aim of the study is:

1. To observe the onset time of sensory and motor blockade.
2. To compare levels and duration of sensory and motor blockade.
3. And to observe associated complications in subarachnoid block using 2.5 mL, 3 mL and 3.5 mL of 0.5% bupivacaine (hyperbaric).

MATERIALS AND METHODS

The prospective randomised clinical study was carried out on 90 patients belonging to ASA grade I and II, posted for elective urogenital, lower abdominal and lower extremities surgeries, under spinal anaesthesia.

90 patients were randomly divided into three groups using envelope method with 30 patients in each group.

1. **Group A:** Patients received 2.5 mL of hyperbaric solution of 0.5% bupivacaine.
2. **Group B:** Patients received 3.0 mL of hyperbaric solution of 0.5% bupivacaine.
3. **Group C:** Patients received 3.5 mL of hyperbaric solution of 0.5% bupivacaine.

Immediately after the injection, the patient was positioned in the supine horizontal position and the following parameters were evaluated. Time of onset of sensory blockade, Maximum level of sensory blockade, Duration of sensory blockade, Time of onset of motor blockade, Maximum level of Motor blockade, Duration of motor blockade.

RESULTS

The onset of sensory and motor blockade was faster with the increasing volumes of the drug. Higher levels of sensory blockade were achieved with the increasing drug volumes. The duration of sensory and motor blockade increased with the increasing volumes of drug. The duration of motor block was directly proportional to the volume of the drug injected.

CONCLUSION

We conclude from our study that the doses of 0.5% hyperbaric bupivacaine can be titrated according to the level and duration of sensory and motor blockade desired using minimum amount of drug necessary. The cardiovascular stability was better at lower volumes of the drug.

KEYWORDS

Bupivacaine, Spinal Anaesthesia, Different Doses of Hyperbaric Bupivacaine, Sensory and Motor Blockade.

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INTRODUCTION: Ever since the discovery of spinal anaesthesia by August Bier in the year 1898 it has enjoyed a widespread acceptability among anaesthesiologists worldwide. Many advantages of this technique are well known and widely accepted. Apart from being economical, it is also technically simple and does not require any sophisticated equipment. Subarachnoid block offers distinct advantages over general anaesthesia, viz.

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Corresponding Author:
Dr. Sherry Mathews,
Qtr. No. E-09, N.I.R.D. Campus,
Rajendranagar, Hyderabad-500030.
E-mail: sherryogh@gmail.com
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- No loss of patient's consciousness.
- Avoidance of polypharmacy.
- Minimal alterations in physiological and biochemical profiles.
- Lesser incidence of complications like aspiration syndrome, prolonged apnoea, and pulmonary complications.
- Avoidance of sequelae of endotracheal intubation.
- Reduced incidence of deep vein thrombosis.

The drug extensively used in India till recently was 5% lignocaine. However, the following disadvantages have limited its use, like.[1]

- Shorter duration of action of not more than 45-60 minutes.

- Use of vasoconstrictors to prolong its action is not advisable because of adverse ischaemic effects on the spinal cord.
- And increased incidence of Transient Neurological Symptoms (TNS).

In recent years, 0.5% bupivacaine has replaced 5% lignocaine for spinal anaesthesia, which has the following obvious advantages:

- Prolonged duration of action without the use of vasoconstrictors.
- Reduced incidence of Transient Neurological Symptoms (TNS).[2]

However, 0.5% bupivacaine also has certain disadvantages like:

- Hypotension, bradycardia.
- Urinary retention.
- And unduly prolonged duration of motor paralysis.

According to Hampl et al,[3] it is not only advisable, but also reasonable to use minimum quantity of local anaesthetics to produce desired level and duration of spinal anaesthesia as per the requirements of surgery. In this way, the undesirable side effects of local anaesthetics maybe reduced or even completely avoided. Furthermore, the early return of sensory and motor activity may improve patient compliance as well. In view of this, various studies have been conducted from time to time to establish the dose response relationship of bupivacaine for spinal anaesthesia. In one such study conducted by Sundnes KO et al,[4] it was found that the increase in the volume of the drug increases the extent and duration of sensory and motor blockade.

However, they observed significant decreases in heart rate and blood pressure in patients receiving higher volumes like 3.5 mL of 0.5% bupivacaine as compared to the patients receiving a lower volume like 3 mL of the same. Hence, studies were conducted to find out the minimum effective concentration of 0.5% bupivacaine so as to avoid the haemodynamic instability associated with the higher volumes of bupivacaine. In another study conducted by Sheskey et al,[5] it was concluded that the duration of analgesia was longer in patients receiving either 3 mL or 4 mL of bupivacaine 0.5% (H) than in patients receiving only 2.0 mL of the same. They also observed that significant number of patients who received 2 mL of 0.5% bupivacaine required supplementation with general anaesthesia because of inadequate blockade. Due to non-availability of adequate literature, a study to find out the minimum effective concentration of 0.5% (H) bupivacaine in spinal anaesthesia is more than desirable. Hence, this clinical study has been planned to titrate different volumes of 0.5% (H) hyperbaric bupivacaine against clinically achieved segmental levels and duration of sensory and motor blockade.

MATERIALS AND METHODS: After obtaining approval from ethical committee and written informed consent of the patients, the prospective randomised clinical study was carried out on 90 patients belonging to ASA grade I and II, posted for elective urogenital, lower abdominal and lower extremities surgeries, under spinal anaesthesia, at Shadan Institute of Medical Sciences, Hyderabad, during the period from August 2014 to July 2015. The sample size of 90 patients was calculated after discussing with the statistician for a power of >90% and alpha value of 5%. The study was designed to compare different volumes of 0.5% bupivacaine (hyperbaric) in subarachnoid block with respect to level and duration of sensory and motor blockade.

Inclusion Criteria:

1. ASA group I and II.
2. Age between 18 to 60 years of both sexes having comparable heights of 150-180 cms and weights of 50-80 kg.

Exclusion Criteria:

1. Patient refusal.
2. Mass lesion in abdomen including pregnancy.
3. Contraindications for spinal anaesthesia viz.
   a. Deformities of vertebral column.
   b. Bleeding disorders.
   c. Uncontrolled hypertension and IHD.
   d. Local skin infection at the site of lumbar puncture.
   e. Pre-existing neurological disorders.

90 patients were randomly divided into three groups using envelope method with 30 patients in each group.

1. **Group A:** Patients received 2.5 mL of hyperbaric solution of 0.5% bupivacaine.
2. **Group B:** Patients received 3.0 mL of hyperbaric solution of 0.5% bupivacaine.
3. **Group C:** Patients received 3.5 mL of hyperbaric solution of 0.5% bupivacaine.

A thorough preanaesthetic evaluation was carried out in all patients. All the patients were investigated preoperatively and the following routine investigations viz., haemoglobin, urine for albumin, sugar, microscopy and random blood sugar were done. All the patients were preloaded with 10 mL/kg of Ringer lactate solution over 20 minutes and a record of pulse rate and blood pressure was made just before the administration of spinal anaesthesia.

After attaching the monitors, the patient was placed in lateral recumbent position and under strict aseptic precautions, lumbar puncture was done using 25G Quincke's needle using a midline approach. The site of puncture was standardised at L3-4 interspace. Then, a hyperbaric solution of 0.5% bupivacaine was injected in the above-mentioned doses at the rate of 0.25 mL/sec[1] immediately after the injection. The patient was positioned in the supine horizontal position and the following parameters were evaluated.

SENSORY:

Time of Onset of Sensory Blockade was defined as the time interval between the completion of injection of local anaesthetic solution to the onset of compete loss of sensation to pinprick with 22G needle in anterior axillary line bilaterally.

Maximum Level of Sensory Blockade was defined as the maximum height of sensory dermatomal level achieved after 20 minutes of the completion of injection of local anaesthetic solution.

Duration of Sensory Blockade was assessed by two segments regression time. It is defined as the time interval from injection of local anaesthetic solution until the maximum level of sensory blockade has decreased by two segments.

Motor Blockade was assessed by Using:
Modified Bromage Scale
Grade 0: No Block.
Grade 1: Inability to raise Extended legs.
Grade 2: Inability to Flex knees.
Grade 3: Inability to Flex ankle.

Intraoperative complications were noted viz.,
Bradycardia: Defined as a fall in heart rate of more than 20% of the basal reading, which was treated with Inj. Atropine (0.02 mg/kg) I.V.

Hypotension: Defined as a fall in blood pressure of more than 20% of the basal reading, which was treated with head low positioning, IV fluid bolus and Inj. Ephedrine I.V. (3-12 mg bolus) as and when needed.

Inadequate Subarachnoid Block: If the duration of spinal anaesthesia did not last longer than the duration of surgery, patient was supplemented with IV sedation/G.A. (General Anaesthesia) and the case was excluded from the study.

STATISTICAL ANALYSIS: Statistical analysis of the data recorded from the three groups was carried out using unpaired student's 't' test for comparing onset and duration of sensory and motor blockade and haemodynamic parameters. X^2 test was used for comparing maximum sensory level of analgesia. A 'p' value of <0.05 was considered to be statistically significant.

OBSERVATION AND RESULTS: Ninety patients undergoing urological, lower abdominal and lower extremities surgeries under spinal anaesthesia were included in the study.

Parameters	Group A	Group B	Group C
Age (yrs.)	35.75±12.8	34.50±11.79	40.61±12.89
Weight (kg)	62.50±6.52	61.50±9.91	64.66±5.71
Height (cms)	166.23±6.32	167.02±5.65	170.10±3.51
Sex (Male/Female)	19/11	20/10	18/12

Table 1: Demographic Characteristics (Mean±SD)

No significant difference was noted between the three groups regarding the demographic characteristics.

Parameters	Group A	Group B	Group C
HR (bpm)	77.35±8.30	75.07±14.41	74.02±9.91
SBP (mmHg)	123.00±7.63	121.00±7.61	123.47±8.90
DBP (mmHg)	83.65±17.32	76.73±5.52	82.13±1.20

Table 2: Baseline Haemodynamic Measurements (Mean±SD)

Parameters (Minutes)	Group A	Group B	Group C
Sensory	2.05±0.25	2.12±0.17	2.02±0.15
Motor	8.50±0.21	9.31±0.23	6.90±0.20

Table 3: Onset of Sensory and Motor Blockade (Mean±SD)

Groups	't' value		'p' value	
	Sensory	Motor	Sensory	Motor
Group A vs. Group B	1.84	4.32	0.09	0.0001
Group B vs. Group C	4.54	23.41	0.0016*	0.0001
Group C vs. Group A	5.51	21.54	0.0002*	0.0001

Table 4: Intergroup Comparison of Onset of Sensory and Motor Blockade

The t-value measures the size of the difference relative to the variation in the sample data.

Group	Frequency (%) of Complete Motor Blockade (Grade-I Modified Bromage Scale)
A	87.64%
B	94.45%
C	97.43%

Table 5: Degree of Motor Blockade

Parameters (Minutes)	Group A	Group B	Group C
Sensory (Two segment regression)	97.12±4.54	95.45±3.90	83.54±5.65
Motor	173.19±24.65	208.41±7.64	254.13±8.09

Table 6: Duration of Sensory and Motor Blockade (Mean±SD)

Groups	't' value		'p' value	
	Sensory	Motor	Sensory	Motor
Group A vs. Group B	1.93	8.73	0.08	0.001
Group B vs. Group C	12.35	24.90	0.001	0.001
Group C vs. Group A	14.35	18.90	0.001	0.001

Table 7: Intergroup Comparison of Duration of Sensory and Motor Blockade

* = p is significant.
Duration of sensory blockade.

(Two segment regression time): A statistically significant difference was found between groups B and C and between group C and A. Thus, the sensory level regressed fastest in group C followed by groups B and A. i.e., the fastest regression of sensory level was seen with larger volumes of drug.

Group	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}
A	0	1	3	1	5	2	8
B	1	4	10	2	3	0	0
C	14	2	5	0	1	0	0

Table 8: Maximal Sensory Level

Distribution of maximal sensory level achieved differed significantly in the two groups by application of chi-square test (X^2).
X^2 value = 93.58.
df (degree of freedom) = 6.
'p' value = 0.0097 (P<0.01).

The highest level of sensory blockade achieved in maximum number of patients was found to be T_{10} in group A, T_4 in group B and T_4 in group C. This indicated a dermatomal difference of two segments between the two groups.

Duration of Motor Blockade: The duration of motor blockade was directly proportional to the volume of the drug injected. By application of the unpaired 't' test, the difference between all 3 groups was shown to be statistically significant.

Parameters	Group A	Group B	Group C
HR (bpm)	69.32±5.3	65.54±6.5	65.34±5.7
SBP (mmHg)	103.43±5.3	102.34±6.1	103.65±5.8
DBP (mmHg)	71.33±4.2	69.45±3.2	71.54±2.3

Table 9: Intraoperative Minimal Haemodynamic Readings

Groups	't' value			'p' value		
	HR (bpm)	SBP (mmHg)	DBP (mmHg)	HR (bpm)	SBP (mmHg)	DBP (mmHg)
Group A Vs. Group B	1.02	0.01	0.16	0.32	1.01	0.89
Group B Vs. Group C	0.15	0.98	0.02	0.83	0.39	1.02
Group C Vs. Group A	0.92	0.89	0.13	0.38	0.37	0.89

Table 10: Intergroup Comparison of Intraoperative Minimal Haemodynamic Readings

No statistically significant difference was noted between the three groups as regards to the minimal heart rate, systolic and diastolic blood pressures. However, maximum fall in systolic blood pressure was in group C followed by group B and group A.

Parameters	Group A	Group B	Group C
Hypotension	1	4	6
Bradycardia	0	2	4
Nausea or vomiting	3	4	5
Shivering	0	1	2
Pain	0	0	0
Back ache	0	2	1
TNS	0	0	0

Table 11: Perioperative Complications

DISCUSSION: Spinal anaesthesia has been used abundantly for the past several decades for various surgeries involving the lower abdomen and lower extremities. Many advantages of this technique are well known and widely accepted. However, it has undergone many alterations both in the technique of administration as well as the drugs and their dosages used. In recent years, 0.5% bupivacaine has replaced 5% lignocaine in spinal anaesthesia for its obvious advantages over the latter. However, studies have shown associated haemodynamic instability with higher volumes of 0.5% bupivacaine. In view of this, various studies were conducted to establish the dose-response relationship of bupivacaine and to find out the minimum effective dose of 0.5% bupivacaine for spinal anaesthesia. However, certain discrepancies existed between various studies concerning the relative influence of volume, dosage and concentration of bupivacaine when administered intrathecally. Hence, in an effort to elucidate this knowledge gap in the literature, we conducted a clinical study to find out minimum effective dose of 0.5% bupivacaine by titrating different volumes of 0.5% bupivacaine (hyperbaric) against clinically achieved segmental levels and duration of sensory and motor blockade. The study was carried out in 90 patients aged between 18 to 60 years of both sexes with comparable heights of 150-180 cms and weights of 50-80 kg belonging to ASA grade I and II, posted for elective urogenital, lower abdominal and lower extremities surgeries.

90 Patients were Randomly Divided into Three Groups	
Group A:	Patients received 2.5 mL of hyperbaric solution of 0.5% bupivacaine.
Group B:	Patients received 3.0 mL of hyperbaric solution of 0.5% bupivacaine.
Group C:	Patients received 3.5 mL of hyperbaric solution of 0.5% bupivacaine.

The mean age, weight and height of the patients in our study in group A were 35.75±12.80, 62.50±6.52 and 166.23±6.32, respectively; in group B, they were 34.50±11.79, 61.50±9.91 and 167.02±5.65, respectively; in group C, the values were 40.61±12.89, 64.66±5.71 and 170.10±3.51, respectively. No significant difference was noted statistically between the three groups as regards to the demographic characteristics. In our study, the mean baseline heart rate systolic and diastolic blood pressures in group A were 77.35±8.30, 123.00±7.63 and 83.65±17.32, respectively. In group B, they were 75.07±14.41, 121±7.61 and 76.73±5.52, respectively and in group C, they were 74.02±9.91, 123.47±8.90 and 82.13±1.20, respectively. Baseline haemodynamic parameters did not show any significant difference between the three groups. The subarachnoid block was then performed under all aseptic precautions.

0.5% bupivacaine (hyperbaric) solution was injected according to the dosages already mentioned above. The following parameters were assessed. The time taken for loss of pinprick sensation was inversely related to the volume of drug used for blockade. The mean onset time of sensory

blockade (Minutes±S.D.) was 2.05±0.25 in group A, 2.12±0.17 in group B and 2.02±0.15 in group C. Thus, the onset time decreased as volume of drug increased. Statistically, significant difference was found between the groups B and C and between groups C and A. The time required for onset of motor blockade was studied. The mean values obtained in our study were (minutes±S.D.): 8.50±0.21 in group A, 9.31±0.23 in group B and 6.90±0.20 in group C. Statistically, significant difference was noted between all the three groups as regards to the onset time of motor blockade. The degree of motor blockade differed significantly between the three groups, i.e. 4 patients in group A and 2 patients in group 3 showed incomplete motor blockade (up to grade I Modified Bromage Scale).

This, however did not interfere with the procedures, which could proceed to completion as adequate level of sensory blockade had been already achieved in all cases. In group C, 97.43% cases experienced complete motor blockade (i.e., 19 out of 20 cases attained grade 3 block according to Modified Bromage Scale). Thus, this factor should be taken into account whilst determining the amount of bupivacaine to be used for surgical procedures requiring complete muscular relaxation (e.g., abdominal surgery). The above observations are in accordance with the studies conducted by Axelsson KH et al[6] who found that onset time to complete motor blockade decreased with increasing volume, i.e., 10 minutes for 4 mL as compared to 20 minutes for 2 mL. A 100% frequency of complete blockade was only obtained with the 4 mL volume.

Alston RP, Littlewood DG et al[7] found statistically significant differences regarding onset times of complete motor blockade between 2 mL and 4 mL of 0.5% bupivacaine (i.e. faster onset with higher doses). Complete motor blockade occurred in 8 out of 10 patients with 3 mL and only in 6 out of 9 patients given 2 mL of 0.5% bupivacaine. Sundnes KO et al[4] found a statistically significant difference in degree of complete motor blockade between the 1.5 mL and 3 mL groups. Regarding the spread of sensory blockade, higher levels of cephalad spread were found in groups B and C as compared to group A. Thus, in group A maximum patients (i.e., 19 out of 30) showed a highest sensory level up to T_{10}. In group B, most patients (i.e., 24 out of 30) showed a maximum sensory level till T_6. In group C, majority of patient (i.e., 16 out 30 each) showed highest cephalad spread up to T_4 sensory level. Similar observations were made by Axelsson KH et al who found that the maximum cephalad spread of analgesia increased with increasing volume. Sensory blockade spread to L_{2-4}, T_{12}, T_{8-10} and T_{6-8} sensory levels in the 1.5 mL, 2 mL, 3 mL and 4 mL groups respectively. They found a significant difference in spread between all the groups (except 3 mL and 4 mL). They found a directly proportional relationship between log of volume of drug and maximum cephalad spread of sensory blockade.

This is in accordance with studies conducted by Sundnes KO et al who found that the mean maximum spread of analgesia tends to increase with increasing volume from T_{10} with 1.5 mL and 2 mL to T_7 with 3 mL, the difference between 1.5 mL and 2 mL and between 1.5 mL and 3 mL being significant ($p < 0.05$). Alston RP et al also found in their study that "bupivacaine 0.5% produced a statistically significant increase in cephalad spread with increasing volume between 2 mL and 4 mL ($p < 0.05$) and 3 mL and 4 mL ($p < 0.05$), but not between 2 mL and 3 mL. These observations are useful in proving that the dose of local anaesthetic drug injected into the subarachnoid space is one of the key factors determining the level of sensory blockade. Yet, the final level achieved would also be influenced by other factors viz. the age, height and position of the patient, the site of injection, the direction of the spinal needle, the rate of injection, barbotage, the CSF volume and the baricity of the solution.

The duration of sensory blockade was assessed by two-segment regression time. Thus, the mean time in group C (83.54±5.65) was lower than that in the group B (95.45±3.90) and in group A (97.12±4.54) min. However, only the differences between the means of group B and C and group C and A were statistically significant ($p<0.05$). Therefore, the fastest regression of sensory level was seen with larger volumes of drugs. This phenomenon of rapid regression of sensory blockade in case of higher blockade was very well exemplified in one case of tibia nailing wherein 3 mL of 0.5% bupivacaine was administered. Here, the maximum cephalad spread up to T_4 level was rapidly achieved and was associated with hypotension and respiratory embarrassment. However, the level regressed by 2 segments within 45 minutes and patient was greatly relieved from circulatory and respiratory complications. This phenomenon could be explained by the fact that the higher spread of sensory blockade resulted in larger exposure area to the blood vessels in the cord, spinal roots, etc., Thus, rapid absorption of drug could be responsible for the faster speed of regression in cases of higher cephalad spread.

A study conducted by Mochamat Helmi, Yusmein Uyun, Bambang S. Suwondo and Untung Widodo explained that the ideal local anaesthetic solution for intrathecal use has rapid onset and reliable duration with less incidence of adverse events. This study was aiming to compare the onset of anaesthesia and duration of action of isobaric and hyperbaric bupivacaine for Subarachnoid Block (SAB).[8] The ED_{50} doses for motor block with 3 bupivacaine concentrations were significantly different in elderly patients; the ED_{50} dose of 0.75% bupivacaine being significantly higher than that of 0.25% bupivacaine.[9]

Axelsson KH et al,[6] however, failed to demonstrate this phenomenon in their study. They found the spread of regression to be similar in the 2 mL, 3 mL, and 4 mL groups. The duration of motor blockade was proportional to the volume of drug injected. Thus, mean duration in our study was found to be (minutes±S.D): 173.19±24.65 in group A, 208.71±8.65 in group B and 254.13±8.09 in group C.

The differences between all 3 groups was found to be statistically significant. These observations are in accordance with those made by Axelsson KH et al who found that the duration of motor blockade increased with increasing volume. They found a significant difference between the 2

mL and 4 mL groups. In none of the cases, did the motor block outline the sensory block. This fact was corroborated by KH Axelsson et al and KO Sundnes et al in their respective studies. This phenomenon can be explained by the nature of the nerve fibres responsible for motor activity. These fibres are the last to be blocked and the earliest to regain normalcy following action of local anaesthetics. We did not note any significant difference between the three groups as regards to minimal intraoperative haemodynamic readings. The minimal recordings of heart rate, systolic and diastolic blood pressure were 69.32±5.3 bpm, 103.43±5.3 and 71.33±4.2 mmHg in group A; 65.54±6.5 bpm, 102.34±6.01 and 69.45±3.2 mmHg respectively in group B and 65.34±5.7 bpm, 103.65±5.8 and 71.54±2.3 mmHg respectively in group C.

However, increased incidence of hypotension, bradycardia and nausea or vomiting was noted with higher volumes of drug. Hypotension was noted in 1 patients in group A, 4 patients in group B and 6 patients in group C. Hypotension was transient and easily treated with rapid administration of intravenous fluids, 3-12 mg of ephedrine and a head low position. Similar reports of increased incidence of hypotension with increasing volumes of drug were made by Sundnes KO et al whereas in another study conducted by Gentili M et al[10] a hyperbaric solution containing 4, 6 or 8 mg bupivacaine was injected into subarachnoid space. They noted stable heart rate and blood pressure throughout the study. The dose of 12.5 mg of isobaric bupivacaine for spinal anaesthesia provides sufficient level of analgesia for surgical correction of hip fractures in elderly patients eliminating the need for the use of vasopressor.[11] Nausea and vomiting was seen in patients who had considerable decrease in their blood pressure. They responded to IV ondansetron 4 mg, oxygenation and restoration of blood pressure. Bradycardia was noted in 2 patients in group B and 4 patients in group C, which responded to IV atropine 0.6 mg. Hence, it was observed that cardiovascular stability was better achieved at lower volumes of the drug. Shivering was observed in 2 patients in group B and 2 patients in group C. It responded to treatment with Inj. Tramadol IV. The most common problem encountered postoperatively was backache. It was, however, acceptable considering the duration of surgery. Moreover, none of these patients requested nor required any treatment for the same. During followup period of 72 hours, none of the patients in our study complained of neurological symptoms.

CONCLUSION: We conclude from our study that the doses of 0.5% hyperbaric bupivacaine can be titrated according to the level and duration of sensory and motor blockade desired using minimum amount of drug necessary.

The cardiovascular stability was better at lower volumes of the drug.

FUTURE SCOPE OF THE STUDY: From above conclusions, it would be interesting to see if larger volume like 5 mL of 0.5% bupivacaine (hyperbaric) can result in even prolonged duration of block without causing much haemodynamic compromise.

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