

## **Effect of baricity of intrathecal Bupivacaine on surgical environment in Urological procedures – A Comparative Study**

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### **Abstract**

A comparative study was done with intrathecal bupivacaine of two different baricities. viz., isobaric 0.25% and hyperbaric 0.50%. The study was done in patients who underwent urological procedures. Surgical environment was compared in both groups. Surgeons were satisfied with surgical environment in both groups. Patients were satisfied with anaesthesia in both the groups. No complications were noted in both groups though all were elderly patients. Isobaric bupivacaine had a slower onset of level of block but produced an intense sensory and motor blockade, like hyperbaric bupivacaine. Height of analgesia and the duration of motor and sensory block were similar between the two groups, probably because the mass of bupivacaine injected was the same. Thus, we conclude that the mass of the drug is more important than the concentration in determining the surgical environment.

**Keywords:** Isobaric bupivacaine, Hyperbaric bupivacaine, Urological procedures, Surgical environment, Mass of the drug.

### **1. Introduction**

Spinal anaesthesia is the ideal anaesthesia for patients undergoing urological procedures such as Transurethral Resection of Prostate (TURP), Transurethral Resection of Bladder Tumour (TURBT), Bladder Neck Incision (BNI) or Endoscopic Internal Urethrotomy (EIU) [1]. Isobaric Bupivacaine produces less extensive block and has an increased duration of action as compared to hyperbaric Bupivacaine [2,3]. Hyperbaric Bupivacaine increases the cephalad spread of analgesia [4,5] and decreases the duration of blockade. The position of the patient during and after injection of isobaric Bupivacaine has no effect on the distribution of the drug. So isobaric Bupivacaine has no effect on the level of spinal anaesthesia [6].

This is a randomized controlled double-blind study. Patients were randomly assigned to either 0.50% or 0.25% Bupivacaine group. The surgical environment was assessed along with sensory block and motor block.

A pilot study was done with 20 patients. The analgesia and motor blockade were adequate. Analysis was done with the data from the pilot study. A sample size of 70 patients for the study was

proposed. There were two groups and each group had 35 patients.

#### **1.1 Review of Literature**

During spinal anaesthesia, while we aim for a block to last for the duration of the surgery, the level of block becomes more than required. So it is wise to confine the spread of spinal anaesthesia only to the area of the surgery. Studies were done with reduced concentration of the local anaesthetic drug, which produced effective block. Because of the lesser dose, rapid recovery was noted.

Hyperbaric and isobaric 0.5% bupivacaine solutions were compared in one hundred and six patients by Suzuki *et al* [3]. Hyperbaric solutions tended to produce higher levels of the block. With isobaric solutions, the duration of the block was prolonged dose dependently. Isobaric with hyperbaric bupivacaine were compared in sixty patients by Martin *et al* [7]. Motor and sensory block developed more rapidly in the isobaric group. The effects of volume and baricity of spinal bupivacaine on block onset, height and duration was studied by Malinovsky *et al* [8]. In this study, the volume of isobaric or hyperbaric bupivacaine had no significant

influence on either cephalad spread or duration of sensory blockade. With diluted hyperbaric bupivacaine the intensity of motor blockade was decreased. For either isobaric or hyperbaric bupivacaine volume had no significant influence on either cephalad spread or duration of sensory blockade. Time for offset of anaesthesia was shorter with hyperbaric bupivacaine compared with isobaric bupivacaine.

The clinical picture of segmental blocking after subarachnoid injection of isobaric bupivacaine and hyperbaric bupivacaine were studied on one hundred and fifty patients by Kozlov *et al* [9]. It showed isobaric bupivacaine providing longest effective analgesia.

Roberts *et al* [10] concluded in his study that isobaric bupivacaine producing lower level of block with increased duration of action compared to hyperbaric bupivacaine producing extensive block with decreased duration of action.

Moller *et al* [4] and Cummings *et al* [11] reported that hyperbaric bupivacaine increased the height of block with decreased duration of block compared to isobaric bupivacaine.

DeWatcher *et al* [5] found out baricity was the main factor in the spread of the bupivacaine in the subarachnoid space.

Veering *et al* [12] noted the time to recovery from analgesia at T<sub>12</sub> segmental level and for the total disappearance of analgesia was longer with isobaric bupivacaine in elderly patients.

It has been noted that the cephalad spread of the subarachnoid bupivacaine is greater in the elderly patients [13-15].

Benign Prostatic Hyperplasia (BPH) is a condition where there is enlargement of prostate. More than fifty percent of men above the age of 60 have BPH. The prevalence increases to ninety percent by the age 85. This condition causes difficulty in passing urine eventually leading to acute retention of urine. Transurethral Resection is the most effective treatment with lowest morbidity [16].

In Transurethral Resection of bladder Tumour a resectoscope is passed into the bladder and the tumour is removed under either spinal anaesthesia or general anaesthesia.

Bladder Neck Incision (BNI) is done in men having difficulty in passing urine due to obstruction from a tight bladder neck. The operation is done via a urethroscope introduced under anaesthesia.

Urological endoscopic surgeries are commonly done under spinal anaesthesia [17].

## 2. Materials and Methods

A pilot study was done in twenty patients to get the sample size to compare the effects of 0.5% hyperbaric bupivacaine and 0.25% isobaric bupivacaine. Following this pilot study the randomized double blind study was conducted on seventy patients coming for elective urological procedures. Patients were divided in to two groups of 35 patients each.

### 2.1 Inclusion criteria

Age between 41 and 80 years

ASA grade 1, 2 or 3

Patients undergoing elective urological procedures such as TURP, TURBT, Endoscopic internal urethrotomy and Bladder Neck Incision.

### 2.2 Exclusion criteria

Patient having age above 80 years (because of the fear of hypotension in very elderly population with increased chance ischaemic heart disease).

Patients with spinal column anomalies

### 2.3 Preoperative preparation

Preanaesthetic check up was done by the anaesthetist on the day before surgery. The procedure was explained and informed consent was obtained. Patient's height, weight and the distance between occipital protuberance and coccyx were measured. Patients received oral diazepam (0.2mg/kg) as premedication, 60-90 minutes prior to surgery.

### 2.4 Randomisation

Patients were randomly allocated in to two groups using the randomization table. Each group consisted of thirty five patients. Group A received 2.5ml of 0.5% hyperbaric bupivacaine in 8% dextrose. Group B, the study group received 5ml of 0.25% bupivacaine. The patients were blinded to the group allocation. The assessment was done by a different anaesthetist who was not involved in the study.

### 2.5 Procedure

After establishing intravenous access crystalloid bolus (10ml/kg) was given to prevent the spinal hypotension. Patient was monitored with continuous ECG, pulseoximetry and non invasive blood pressure.

### 2.6 Technique

Patients in group A received 2.5ml of 0.5% hyperbaric bupivacaine. Patients in group B received 5ml of study drug. The study drug was prepared by adding 2.5ml of distilled water with 2.5ml of 0.5% hyperbaric bupivacaine. The patient was kept in the lateral position with full flexion at neck, hip and knee for easy identification of the interspinous spaces. Povidone iodine solution was used to clean the back of the patient. Lumbar puncture was done using 25G disposable Quincke-Babcock spinal needle at L3-4

interspace under strict aseptic precaution. Once the needle position was confirmed by free aspiration of cerebrospinal fluid, the local anaesthetic solution was injected over a period of twenty seconds without barbotage. Immediately after the injection patients were positioned supine. After fifteen minutes patients were positioned in the lithotomy position.

## 2.7 Assessment of the patient and recordings

- 1) Heart rate, blood pressure and arterial oxygen saturation were recorded before the start of the spinal anesthesia as baseline values. After that the recordings were done immediately after the injection of the drug, every minute for the first five minutes and every five minutes for the first half an hour. Thereafter they were recorded every fifteen minutes until the end of the procedure.
- 2) If there were drop of 25% in the highest recorded prespinal systolic blood pressure intravenous fluid was administered rapidly and then if necessary Mephentermine sulphate was given at incremental doses.
- 3) Heart rate less than 50 per minute was treated with intravenous incremental doses of atropine.
- 4) The spinal anaesthesia level was tested from the time of injection of the local anaesthetic drug until the block completely regressed. The sensory level was tested by loss of pinprick sensation using hypodermic needle. The onset, intensity and duration of sensory block were recorded. The onset of sensory block was taken as the time of achievement of block to T<sub>12</sub> from the time of injection of the local anaesthetic drug. The intensity of block was noted by checking the block at the largest nerve, S1 dermatomal area.
- 5) The motor block was assessed using the Bromage scale [18,19].

No block (0%): Full flexion of knees and feet possible (No paralysis)

Partial block (33%): Just able to flex knees, still full flexion of feet possible (Unable to raise the extended leg)

Almost complete (66%): Unable to flex knees, still flexion of feet possible (Unable to flex knees)

Complete block (100%): Unable to move legs or feet (Unable to flex ankle)

The onset of motor block was taken as the time of achieving 33% block from the time of injection. The duration of motor block was taken as the time from the onset of 33% block until the reappearance of 33% of the motor block [20].

- 1) The drugs and intravenous fluids (Both name and amount) used during the procedure were noted.
- 2) After complete regression of the block patients were sent to ward from recovery room. Follow up of patients were done for the next 24 hours and looked for any complications of spinal anaesthesia such as headache, backache and neurological deficit.

## 2.7 Statistical Methods

The statistical analysis was done using SPSS PC+ software. Comparison of the different variables between the two groups was done by Students t-test and Chi-square test.

## 3. Results

Seventy patients took part in the study. They were randomly allocated into two groups of thirty five patients each i.e. Group A and Group B. Group A received 2.5ml 0.5% hyperbaric bupivacaine and Group B received 5ml of 0.25% isobaric bupivacaine. P value <0.05 was considered as significant.

### 3.1 Demographic data

Table 1: Showing distribution of Demographic data

Variables		Control group		Study group		p-value
		Mean	SD	Mean	SD	
Age (Years)		60.51	7.18	59.03	9.85	0.473
Sex	Male	33		35		0.4976
	Female	2		0		
Height (cms)		165.97	6.10	165.63	4.87	0.796
Weight (kgs)		60.86	10.29	56.91	10.43	0.116
Spinal column Length (cms)		71.51	4.19	71.06	3.88	0.637

There is no significant difference in the distribution of age, sex, height, weight and spinal column length between the groups.

### 3.2 Distribution of surgeries (Table 2)

Table 2: Showing Distribution of surgeries

Surgeries	Control group	Study group
TURP	18	24
TURT	10	6
EIU	4	5
BNI	3	0

There is no significant difference in the distribution of surgeries between the two groups. (p- value 0.17414)

### 3.3 Onset of sensory and motor block (Table 3)

**Table 3: Showing Onset of sensory and motor block**

Onset of block (Minutes)	Sensory block		Motor block	
	Control	Study	Control	Study
One	21	20	21	11
Two	13	13	14	18
Three	1	2	0	5
Five	0	0	0	1
p - value	0.8362		0.0220	

Onset of sensory block was quicker in the hyperbaric bupivacaine. But this is not clinically significant since none of the patients in the study group exceeded three minutes for the onset of sensory block. This was not significant statistically also (p-value 0.8362).

For the onset of motor block it took three minutes for five patients and five minutes for one patient in the study group. Thus the onset of motor block was slow in isobaric bupivacaine, which was statistically significant (p- value 0.02204).

### 3.4 Maximum height of sensory block (Table 4)

**Table 4: Showing Maximum height of sensory block**

Maximum height of Sensory block	Control group	Study group	z -value
T6 and above	12	17	1.27
Below T6	23	18	1.74

There was no significant difference in maximum height of sensory block achieved in patients of both groups. Z value greater than 1.96 is statistically significant.

### 3.5 Duration of sensory and motor block (Table 5)

**Table 5: Shows Duration of sensory and motor block**

Variable	Control group		Study group		p - value
	Mean	SD	Mean	SD	
Duration of Sensory block (minutes)	118.06	23.637	121.09	24.395	0.600
Duration of Motor block (minutes)	138.83	26.281	139.91	35.999	0.886

There is no statistical difference in duration of both sensory block and motor block between both the groups of patients.

### 3.6 Postoperative Complications

All the patients were followed up until discharge from the hospital. None of the patients in both the groups had any complications. All the patients were satisfied with respect to anaesthesia. None of the patients had intraoperative pain. Patients were happy with the duration of analgesia as well. Surgeons did not find any difference in the surgical environment in both the groups since analgesia was adequate.

## 4. Discussion

This research work was undertaken to compare the effects of hyperbaric bupivacaine with isobaric bupivacaine in patients undergoing endoscopic urological procedures under subarachnoid block. Sensory block, motor block, perioperative complications and surgical environment were compared. Most of the patients coming for the endoscopic urological procedures are elderly having co-morbidities such as ischaemic heart disease, hypertension and diabetes mellitus[21].

There are many studies done with reduced concentration of isobaric bupivacaine. One of the

major clinical advantages of isobaric bupivacaine is that position of the patient during and after injection has no effect on the distribution of the anaesthetic and thus no effect on the level of anaesthesia. It is very useful in situations where levels of anaesthesia T<sub>10</sub> or below are required. Isobaric bupivacaine is not used frequently in situations where higher level of anaesthesia is needed.

Concentration, dose and volume of local anaesthetic injected – all affect the distribution of anaesthesia. Separation of the individual effects on distribution of these three variables is difficult since changing one of the three affects either or both of the other two variables.

Shesky *et al*[22] did a double blind study in which age, height, position and other factors that affect distribution were controlled. Levels of anaesthesia were significantly higher in patients given 15 or 20mg of bupivacaine than in patients given 10mg. The levels of anaesthesia were similar in patients given the same dose of bupivacaine even though the concentration and volume of bupivacaine injected differed. Also the patients who received the same volume but higher concentration bupivacaine

had significantly higher level of anaesthesia. They came to the conclusion that in determining spread of local anaesthetic solution in CSF, the total dose of bupivacaine is more important than the volume or concentration of anaesthetic solution. Our study also agrees with this. The analgesia, sensory block and motor block were adequate in both the groups.

#### 4.1 Onset of sensory block:

There is no significant difference in the onset of sensory block between both the groups. This is not in agreement with the previous studies. Martin *et al* [7] noted that the sensory block developed more rapidly in the isobaric group. According to Suzuki *et al* [3] the sensory block developed more quickly in the hyperbaric bupivacaine.

#### 4.2 Onset of motor block:

The onset of motor block was delayed in the study group, which was statistically significant (p value 0.02204). This is in agreement with Suzuki *et al* [3] study. But Martin *et al* [7] noted motor block developing more rapidly in the isobaric group. In our study although the onset of motor block was delayed in the isobaric bupivacaine group, it did not affect other factors such as intensity of motor block, duration of motor block or surgical environment. Also it did not delay the start of the surgery compared to the hyperbaric bupivacaine.

#### 4.3 Extent of sensory block:

The mean maximum level of analgesia achieved by hyperbaric bupivacaine was T<sub>3</sub> and by isobaric bupivacaine was T<sub>4</sub>. This is not in agreement with other studies [4,10,11], which found that isobaric bupivacaine produced a lower level of block. In our study the desired level of analgesia was T<sub>10</sub>, which could have been achieved with lesser mass of bupivacaine in both the groups because Suzuki *et al* [3] found that anaesthetic levels tended to increase with increasing dosage in both groups.

#### 4.4 Duration of block:

There is no statistical difference in the duration of sensory block and motor block between both the groups. The level of analgesia, degrees of sensory and motor blockade achieved with patients of both groups were similar. In studies done by Axelsson [22,23], Moller<sup>4</sup> and Chambers[24] the duration of block was longer with isobaric bupivacaine, which was not in agreement with our study. Our study showed that the onset, extent and duration of block were not affected by the drug concentration, which shows that the mass of the drug injected is more important than the concentration.

#### 4.5 Supplementation:

The analgesia achieved was excellent in both the groups. Both hyperbaric bupivacaine and isobaric bupivacaine provided adequate sensory

block and motor block in all patients. Hence none of the patients needed supplementary medications for analgesia.

All the patients were followed up postoperatively until discharge from the hospital. None of the patients had complications such as post spinal headache, neurological deficit etc. Surgeons were happy with the surgical environment. In addition patients were satisfied with anaesthesia in both the groups.

## 5. Conclusion

There is no difference between isobaric bupivacaine and hyperbaric bupivacaine in producing adequate motor and sensory block when the mass of bupivacaine was kept constant for endoscopic urological procedures such as Transurethral Resection of Prostate, Transurethral Resection of Bladder Tumour, Bladder Neck Incision or Endoscopic Internal Urethrotomy.

The onset of level of block was slower in isobaric bupivacaine but produced an intense sensory and motor block like hyperbaric bupivacaine. Height of analgesia and duration of motor and sensory block were similar in both the groups probably because the mass of bupivacaine injected was same. Thus we conclude that the mass of the drug is more important than the concentration in determining the height and other characteristics of spinal blockade. Surgeons were happy with the surgical environment and patients were satisfied with anaesthesia in both the groups.

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