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Original Research Paper

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COMPARISON OF INTRATHECAL USE OF ISOBARIC AND HYPERBARIC BUPIVACAINE DURING LOWER ABDOMEN SURGERY IN I.Q CITY MEDICAL COLLEGE AND MULTISPECIALITY HOSPITAL, DURGAPUR, WEST BENGAL, INDIA

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ABSTRACT

BACKGROUND: Bupivacaine is an amide local anaesthetic used in hyperbaric and plain forms administered as spinal anesthesia. It is the most commonly used local anaesthetic for spinal anesthesia (SA). There are two forms of commercially available bupivacaine; isobaric bupivacaine (IB): a formulation with a specific gravity or density equal to cerebro spinal fluid and hyperbaric bupivacaine (HB): a formulation with density heavier than cerebro spinal fluid. It is widely believed that the choice between isobaric bupivacaine and hyperbaric bupivacaine formulations alters the block characteristics for the conduct of surgery under spinal anesthesia.

AIMS AND OBJECTIVE: The aim of this study was to systematically review the comparative evidence regarding the effectiveness and safety of the two formulations when used for spinal anesthesia for adult and to compare the use of isobaric and hyperbaric bupivacaine during lower abdomen surgery and their outcome.

METHODS AND MATERIAL: Sixty patients who underwent lower abdominal, hips, and lower extremity surgeries were randomized into two groups. Group I received 20 mg of 0.5% isobaric bupivacaine, while Group II received 20 mg of 0.5% hyperbaric bupivacaine. Injection was made intrathecally in midline position at L3-4 interspace in sitting position.

RESULT: Six patients were dropped out due to failed block and the duration of surgery being longer than 120 minutes. The remaining 54 patients (27 each groups) followed all the study procedure. Patients in both groups were comparable. Surgery lasted for 83 ± 19minutes in Group I and 77 ± 19 minutes in Group II ($P = 0.23$).

CONCLUSION: Isobaric produced more rapid onset and longer duration when compared to hyperbaric bupivacaine.

KEYWORDS : Isobaric bupivacaine, hyperbaric bupivacaine, spinal anesthesia.

INTRODUCTION:

Bupivacaine is a local anesthetic that is largely used for spinal anesthesia, mainly as a hyperbaric or plain solution [1,3]. Controversy exists regarding the predictability of the levels of analgesia achieved with isobaric solution when compared to hyperbaric [4–6]. Virtually local anesthetics used for spinal anesthesia are mostly available as hyperbaric solutions and it is well established that the addition of dextrose to increase the specific gravity of the solutions alters the anesthetic profiles [1, 3, 7, 8]. Density varies inversely with temperature. The actual change in density with temperature cannot be predicted with different solutions. The temperature of local anaesthetic rapidly equilibrates with the core temperature of the CSF (37-38°C). In order to determine accurately the baricity that dictates the spread of local anaesthetic, the density of CSF and the density of the local anaesthetic must be measured at 37-38°C [8]. Even though hyperbaric and isobaric solutions have been extensively studied until now, the comparison of these two solutions from the same manufacturer without any adjuvant for SAB is not yet reported. This study aimed to compare the onset of anesthesia and duration of action of isobaric and hyperbaric bupivacaine 0.5% for SAB.

AIMS AND OBJECTIVE:

1. To determine the effectiveness of HB compared to IB for SA in patient undergoing surgeries of the lower body assessed as success rate of SA.
2. **To** determine the onset time, duration of blockade and regression of spinal block, compared between HB and IB for SA in patients undergoing surgeries of the lower body.

MATERIAL AND METHOD:

The medical ethical committee approved this study. Sixty patients with ASA I and II, undergoing elective lower abdominal surgeries with the estimation in duration of no longer than 120 minutes were enrolled. This study was conducted in I.Q city Medical College and Multispecialty Hospital, Durgapur, West Bengal, from March to July 2019. **Exclusion criteria** included patient's refusal to participate in the study, coagulopathy, anticoagulation therapy, presence of cutaneous infection at the site of the planned puncture, or systemic infection, untreated hypovolemia, progressive cardiomyopathy class III, chronic renal failure receiving hemodialysis, peripheral neuropathy, autonomic dysfunction, history of lumbar surgery making needle puncture impossible, grossly deformed vertebral column, increased intra-abdominal girth secondary to an expanding tumor, a mass or ascites, pregnancy, and allergy to local anesthetics. Drop-out was made when the surgery was more than 120 minutes and severe hemodynamic instability, total spinal, allergic reaction, failed block, and the conversion to general anesthesia took place. Preoperatively, physical examinations and supportive investigations (i.e., routine laboratory, ECG, and chest X-ray) were made one day prior to surgery. Patients were randomized with sealed envelope method into two groups; Group I received isobaric bupivacaine, while Group II received hyperbaric bupivacaine. Neither anesthesiologist performing SAB or collecting perioperative and postoperative data nor the patients were aware of the used solution. After monitoring, preanesthetic hydration which consisted of 10 mL/kg of a crystalloid solution was infused over

20–30 min via an 18-gauge cannula. After injection of spinal anesthetic drug, fluids were administered on the basis of changes in arterial pressure and urinary output. Blood loss was replaced with a crystalloid solution on a 3: 1 basis until estimated or measured hematocrit reached 35%; further losses were replaced by blood. Soon after proper sterility and disinfection procedure, SAB was performed using midline approach in the sitting position, in the L3-4 interspace with 25 G Quincke spinal needle (B-Braun, Melsungen, Germany) with the tip heading toward the head (cephalad). A clear-constant flow of cerebrospinal fluid (CSF) leakage from spinal needle indicated a correct position of needle tip in the subarachnoid space. In all patients, 20 mg (4 mL) of either

0.5% isobaric or hyperbaric bupivacaine solution (Buvanest, Kalbe Farma, Jakarta, Indonesia) was injected without barbotage in the speed of 0.2 mL/sec. Immediately after the injection, the patients were turned back to the horizontal supine position and a pillow was placed under the head for the rest of the study.

STATISTICAL ANALYSIS:

Data were analyzed using SPPS 20.0 software. Results were expressed as mean ± standard deviation (SD). Continuous variables analyzed with student t-test, while the chi-square test was used to compare discrete variables. $p < 0.005$ were considered significant, and exact values are given when < 0.001.

RESULT:

Six patients were dropped out due to failed block and the duration of surgery being longer than 120 minutes. The remaining 54 patients (27 each groups) followed all the study procedure. Patients in both groups were comparable, as in the demographic data (Table 1). Surgery lasted for 83 ± 19minutes in Group I and 77 ± 19 minutes in Group II ($P = 0.23$).

Table 1: Demographic data.

	Group-I	Group-II	*P*
Age (years)	38 ± 14	38 ± 9	0.90
Sex (male/female)	18/9	17/10	0.32
Weight (kg)	57 ± 8	60 ± 6	0.20
Height (cm)	158 ± 7	159 ± 6	0.63
SAP (mmHg)	131 ± 11	128 ± 10	0.21
DAP (mmHg)	79 ± 9	81 ± 7	0.47
MAP (mmHg)	97 ± 9	97 ± 6	0.95
ASA (I/II)	16/1	18/9	0.30

Mean ± SD. Group I: isobaric; Group H: hyperbaric; SAP: systolic arterial Pressure; MAP: mean arterial pressure; DAP: diastolic arterial pressure; ASA: Preoperative status based on the American Society of Anesthesiologists.

Table 2: Block characteristics.

	Group-I	Group-II	*P*
Onset (minutes)			
Sensory	4.8 ± 2.2	7.5 ± 2.2	<0.001
Motor	4.1 ± 2.1	6.4 ± 2.4	<0.001
Duration (minutes)			
Sensory	276 ± 30	163 ± 22	<0.001
Motor	266 ± 32	163 ± 24	<0.001

Mean ± SD. Group I:Isobaric; Group II : hyperbaric

SENSORY AND MOTOR BLOCKADE:

The measured sensory blockade and motor blockade are the onset and duration (Table 2). The onset of sensory blockade was significantly shorter in Group I when compared to Group II ($P < 0.001$). Duration of sensory block was the time measured from the time of the highest block for the regression to the S2 dermatome, which is significantly longer in Group I compared to Group H ($P < 0.001$). The onset of motor block was also shorter in Group I than Group H ($P < 0.001$), while the duration of motor block, the time measured from the achievement of Bromage 3 until regression to Bromage 0, was longer in Group I when compared to Group II ($P < 0.001$).

DISCUSSION:

This study showed that isobaric bupivacaine produced more rapid onset of anesthesia and longer duration of action when compared to hyperbaric bupivacaine. In our study, the only variable was baricity, since dose, volume, and concentration were kept constant and even both solutions are produced by the same manufacturer. The isobaric bupivacaine (Buvanest 0.5%) used in this study is an isotonic bupivacaine HCL 5mg/mL, while the hyperbaric bupivacaine (Buvanest Spinal 0.5% Heavy) is an isotonic bupivacaine HCl 5 mg/mL and dextrose monohydrate 80mg/mL.

Baricity influenced the distribution of local anesthetic solution in the CSF. It is defined as the ratio of density (mass/volume) of local anesthesia solution's density compared to CSF density in 37°C. Thus, baricity influences local anesthetic spread and block height since gravity causes hyperbaric solutions to flow downward in the CSF, whereas hypobaric solutions tend to rise. In contrast, gravity has no effect on the distribution of truly isobaric solution [1, 8, 9, 10].

In our study, isobaric showed more rapid onset of anesthesia and longer duration of action than hyperbaric. Another important finding is that there was a lower blockade with hyperbaric solutions, which is consistent with previous studies [2, 4, 6, 11, 12], while other studies also proposed that hyperbaric solutions may be more suitable to reach the higher thoracic dermatomes as opposed to their plain (i.e., isobaric) [5, 6]. However, only by comparing similar volumes and doses can this difference be accurately assessed. The reasons for this differential effect are speculative, but it could be explained by the properties of the two drugs in relation to gravity and the mass movement of CSF as a result of the postural changes [1, 11, 13]. Gravity will tend to keep the hyperbaric solution near the lowest point of the thoracic curve (T4/T5) in the supine position and to resist attempts to move it further in a cranial direction. This tendency could be further assisted by the viscosity of the hyperbaric solution, preventing it mixing with the CSF [1, 2, 5–14]. The plain solution, however, mixing freely with CSF, has neither gravitational nor viscous effect to constrain its movement within the displaced CSF.

CONCLUSION:

In conclusion, isobaric bupivacaine produced more rapid onset and longer duration compared to hyperbaric bupivacaine.

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