Level of Sensory Block and Baricity of Bupivacaine 0.5% in Spinal Anesthesia

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ORIGINAL PAPER
SUMMARY
Introduction: Bupivacaine is anesthetic often used in spinal anesthesia in the hyperbaric form (with factory-made incorporated 8.25% glucose), and in isobaric form without additives, (so-called "plain"). Baricity manipulation of local anesthetic is made for the better match of necessary and achieved level of sensor block. Too high block is unnecessary and can compromise the patient's hemodynamic status. Objective: To compare gained height and coherence of sensor block using hyperbaric and isobaric 0.5% bupivacaine. Patients and methods: Sixty patients were subjected to the elective operating orthopedic, urological or gynecological surgery in spinal anesthesia. Randomly selected thirty patients received 3 ml of hyperbaric 0.5% bupivacaine, while thirty others received 3 ml of isobaric 0.5% bupivacaine by an identical protocol. After application of anesthesia, the development of all modalities of the block was checked. Finally, after 20 minutes, the height of sensor blocks were determined by an insulin needle (pin-prick test) and that value was taken as the final. Results: All blocks were sufficient to perform surgery. In the hyperbaric group the highest recorded level of the block was first thoracic segment–T1 (3.33%) and the lowest level was seventh thoracic segment T7 (6.66%). In the isobaric group the highest recorded level was T5 (3.33%) and the lowest was L2 (3.33%). Modus as the most frequent value in the series of the hyperbaric group was T5, and in the isobaric T10 ($p < 0.01$). Conclusion: Hyperbaric 0.5% bupivacaine because of the amount of the block may be adequate for all operational procedures that are made in the spinal anesthesia, but sometimes gives unnecessary high block that can give significant changes in the pressure and in the pulse. Isobaric 0.5% bupivacaine gives a very comfortable anesthesia for surgeries in which sensory block of T 10 is sufficient.

Key words: spinal anesthesia, sensory block.

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1. INTRODUCTION

Bupivacaine is an anesthetic that was introduced into clinical practice in 1963. It is used in all aspects of locoregional anesthesia, except for intravenous regional anesthesia and topical anesthesia. It is one of the most commonly used anesthetics in spinal anesthesia. Mostly is used in the form of hyperbaric local anesthetic to which is added glucose in order to enhance mass density and to increase baricity, and in the form of isobaric anesthetic by baricity approximately corresponds to cerebrospinal fluid (1). Manipulation of mass density and baricity of the spinal anesthetics, including bupivacaine seems to affect its spread within the subarachnoid space. Each surgery under spinal anesthesia (usually is a case of infraumbillical procedures) requires a certain amount of sensory blockade, that would be for the patient comfortable and painless. Although it is an ideal that is practically a rare event, just use a different baricity anesthetic is an attempt to find the major similarities and achieve the necessary level of sensory block (2, 3).

Important issue that is related to the level of sensory block is that with higher sensory block occurs also a higher sympathetic block. As the sympathetic block is higher also vasodilatation, particularly of large veins is prominent and the possibility of excessive hypotension during spinal anesthesia is greater. Classic teaching is that the sympathetic block in spinal anesthesia is spread in at least two segments cranially more than sensory block (4). Unnecessarily high block can lead to adverse hemodynamic changes and in extreme cases, a significant pressure drop and severe bradycardia, and therefore the level of sensory block should be adequate as possible with the needs of the surgery. It should be noted that there are some factors that influence the spread of anesthetic in the CSF and the most important are: the amount of anesthetic, the volume and concentration of anesthetic, level of the interspinal area where the anesthetic is administered, and the position of the patient (5). In this article we try to equalize these factors as much as possible through a unified anesthetic procedure.

In the literature is present a number of studies dealing with this issue which give conflicting and confusing informations for practitioners and unclear results and conclusions when it comes to influence of the bupivacaine baricity at the degree of sensory block in spinal anesthesia (6, 7).

2. GOAL

The goal is to compare the amount and coherence of sensory block in spinal anesthesia with hyperbaric and isobaric 0.5% bupivacaine.

3. PATIENTS AND METHODS

The research was carried out in form of prospective study involving 60 patients from Cantonal Hospital "Dr Irfan Ljubijankic" in Bihac. For patients had been planned elective surgery under spinal anesthesia. It was a case of surgical procedures on the lower extremities, perineum, and reconstructive gynecologic surgery in the pelvic base, urethra and prostate by transurethral approach. All patients belonged according to the previous state of health to the Classification of the American Association to anesthesiological level I and II. A random selection of 30 patients received 3 ml 0.5% hyperbaric bupivacaine supplemented with 8.25% glucose, while the other 30 patients received 3 ml 0.5% isobaric bupivacaine. Premedication consisted of 0.05 mg/kg midazolam, given intramuscularly.

Upon arrival in the operating room each patient was monitored continuous ECG, noninvasive blood pressure measured, pulse oximetry, and intravenous cannula was placed. The patient was placed in a sitting position in which lumbar puncture was performed by a median approach in the space between the third and fourth lumbar vertebra (L3-L4). Puncture was made with the Quincke-25G needle thickness. Tip of the needle was directed cranially and the anesthetic was injected over 10-15 seconds. Immediately following administration of anesthetic patient was placed in position lying on the back. The degree of sensory block was monitored by "pin-prick" test after 20 minutes after injection of anesthetic, using thick 25 gauge needle so called "Insulin needle". If there was a difference between left and right sides of the body at the level of sensory block taken is the mean value of both sides.

All patients were given written informed consent for surgery, anesthesia and all the tests during treatment. All procedures in which the patients underwent are routine and are conducted in order to achieve a better therapeutic approach to the patient.

4. RESULTS

Both groups of patients were comparable in terms of patients' age, sex and ASA status. Immediately following administration of anesthetic and placing the patient in dorsal position followed was the development of sensory block at the beginning by "cold test " (the inability of the patient to feel the coolness of cotton wool soaked in alcohol), to the final result which is recorded degree of block verified by insulin needles. After 20 minutes operative field was cleaned so that further testing was not conducted because it would endanger the principles of antisepsis. Detailed results are presented in Table 2 and Figure 1.

The highest level of anesthesia in the hyperbaric group was T1 (the level of first thoracic spinal nerve) in only one patient (3.3%) and lowest level of T7 for two patients (6.66%). In the isobaric group highest level of anesthesia was T5 in one patient (3.33%) and lowest L2 also in one patient (3.33%). Mode as the most frequent value in a series of hyperbaric group was the level of anesthesia T5 (level just below the moms) and in isobaric group was T10 (level of umbilicus).

Based on the calculated values of c^2 tests (c^2 =53.733, p=0.000), we can conclude that there is a highly significant difference (p <0.01) in the distribution of the level of anesthesia due to the difference in the application of anesthetics: for the hyperbaric group it's T5 and in isobaric T10.

By using hyperbaric bupivacaine 26 patients (86.66%) had a level of anesthesia ranging T3-T7. Isobaric bupivacaine in 21 patients (70%) produced a level of

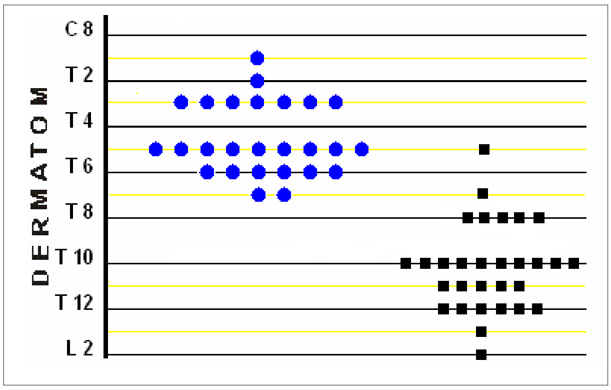

FIGURE 1. Presentation of the upper level of sensory blockade in individual patients in relation to the anesthetic baricity

	Bupivacaine -hyperbaric	Bupivacaine -isobaric
Number of patients	30	30
Gender (M/F)	19/11	20/10
ASA status (I/II)	20/10	18/12
Average age	51	56
Type of surgery:		
Lower limb	15	13
Urology	12	11
Gynecology	3	6

TABLE 1. Patient's features and types of surgeries

No.	Anesthesia level	Hyperbaric	Isobaric	
1.	T1	1	0	1
2.	T2	1	0	1
3.	T3	6	0	6
4.	T4	6	0	6
5.	T5	9	1	10
6.	T6	5	0	5
7.	T7	2	1	3
8.	T8	0	5	5
9.	T9	0	0	0
10.	T10	0	10	10
11.	T11	0	5	5
12.	T12	0	6	6
13.	L1	0	1	1
14.	L2	0	1	1
15.	L3	0	0	0
16.	L4	0	0	0
17.	L5	0	0	0
-	-	30	30	60

TABLE 2. Analysis of sensory block level in spinal anesthesia with hyperbaric and isobaric 0.5% bupivacaine

anesthesia ranging from T10-T12.

In figure 1 blue circles represent the upper level of sensory blockade in individual patients which received hyperbaric anesthetic, a black square in the patients who received isobaric anesthesia. Hyperbaric anesthesia is more coherent because its upper limit of sensory block, taking all subjects distributed in the range of seven dermatomes (T1-T7), while isobaric anesthesia is in the range of ten dermatomes (T5-L2).

5. DISCUSSION

The obtained results show that hyperbaric anesthetic mostly produce anesthesia at the level of medium-high thoracic block which is consistent with the observation that the two lowest points of CSF space in the supine patient's position is level of sixth thoracic vertebra (T6) and the area of the sacrum. After application the local anesthetic injected at the level of L3-L4 is not distributed homogeneously. Instead, the concentration of anesthetic in the cerebrospinal fluid decreases as a function of distance from the spot where the anesthetic is given, i.e. "epicenter" where is the highest concentration (8). The existence of various concentrations at some distance from the point of maximum concentration also means that the effect on the nerve tissues is lower as the distance is greater. Hyperbaric anesthetic because of its significantly greater density compared to the cerebrospinal fluid, or due to a larger baricity strives to reach the lowest point of CSF space. In this way we achieve that anesthesia is usually sufficient to perform surgery in the lower abdomen and cesarean section. Often the use of hyperbaric local anesthetic because of the high block is associated with pronounced hypotension and bradycardia, which requires the application of specific measures and procedures to prevent excessive hypotension: hydration, preventive administration of vasopressors or in case of pregnant women so called "left trapped position" to avoid the pressure of the uterus to the inferior vena cava, around which leads constant debate about their effectiveness. In any case we should not lose from sight that the moderate decrease in pressure in the spinal anesthesia may not necessarily be treated as a complication, but in certain circumstances is a desirable event (9).

Theoretically, from the isobaric bupivacaine we might expect that after the application it is "floating" in the liquor in the vicinity of administration point and thereby block the spinal nerves at the level of L1 (10). However, in practice this has not always been so, several studies indicating the unreliability and unpredictability of this agent in the sense that it can give a very different level of sensory block (6, 11). The results of this survey indicate that 28 patients or 93.33% had sensory block above T12, enough to perform surgery of the lower extremities, endoscopic urology, prostate surgery, perineal and anal surgery. Only in two cases (6.66%) patients had lumbar block level, which can potentially be insufficient for surgery of the e.g. hip. The possible reason for the significant variability is that the density of isobaric bupivacaine was higher at room temperature than liquor temperatures and under such circumstances, an anesthetic that is usually considered clinically isobaric starts to behave like hypobaric. Reaching the liquor, its temperature becomes 37C° within 60 seconds, and in that short period anesthesia can significantly change its main characteristics-baricity (12). In some of mentioned studies we do not see that this was taken into account, so it is possible that if the patient is immediately placed in laying position after application of the anesthetic, now hypobaric anesthetic showed the intention that as lighter than the liquor in a sitting position, reach high and produces high or even very high thoracic block.

6. CONCLUSION

Hyperbaric bupivacaine 0.5% may be an option for all infraumbillical surgical procedures, but in certain situations gives unnecessarily high block. It is highly recommended for surgical procedures in the lower abdomen, including e.g. caesarean section, hernioplastic of the inguinal hernia, transabdominal prostatectomy.

Isobaric 0.5% bupivacaine provides very comfortable anesthesia for surgical procedures on the lower limbs, transurethral resection of the prostate, and surgery of the anorectum by trans anal approach and surgical treatment of pelvic base insufficiency and urogynecology.

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