

Comparative Study of Intrathecal Isobaric and Hyperbaric Ropivacaine in Elective Caesarean Section

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Abstract

Background: For patients undergoing lower abdomen surgery, spinal anaesthesia is a common, safe, affordable, simple-to-use, and successful approach that provides quick and dependable anaesthesia with muscle relaxation.

Aim: To evaluate the effects of isobaric versus hyperbaric ropivacaine in patients having caesarean section.

Methods: Patients admitted for elective caesarean deliveries participated in this prospective observational clinical study. The study period lasts for a full calendar year, from September 2021 to August 2022. 80 patients in total, ages 21 to 30, ASA physical status 1 and 2, were scheduled for elective Caesarean birth under spinal anaesthesia. Two groups of 40 patients each are created from these patients. Patients in Group H received 2 ml of 0.75% hyperbaric Ropivacaine in dextrose 80 mg/ml, while those in Group I received 2 ml of 0.75% isobaric Ropivacaine (isobaric group).

Results: The moment sensory block started to set in, there was no discernible difference. When compared to the hyperbaric group (Group-H), the time from injection to the height of the sensory block is much longer in the isobaric group (Group-I). In the isobaric group, modified bromage grade 3 takes longer to manifest than in the hyperbaric group. Because the rate of motor regression is quicker in the hyperbaric group than in the isobaric group, patients in the hyperbaric group can be mobilised earlier than those in the isobaric group. There was little difference between the two groups' in respect to intraoperative hemodynamic variables and side effects.

Conclusion: In comparison to isobaric ropivacaine, which is needed for day care surgery where prolonged immobilisation is desired, hyperbaric ropivacaine produced a more consistent, dependable, and good quality of motor block with quicker onset, early mobilisation, and rehabilitation.

Keywords: Hyperbaric Ropivacaine, Caesarean Section, Prolong Immobilization

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Introduction

For patients undergoing lower abdomen surgery, spinal anaesthesia is a common, safe, affordable, simple-to-use, and successful approach that provides quick and dependable anaesthesia with muscle relaxation. Lignocaine, Bupivacaine, Levobupivacaine, and Ropivacaine are a few local anaesthetics that are frequently used for spinal anaesthesia. A variety of local anaesthetics and additives that enable control over the level, the time of onset, and the duration of spinal anaesthesia contribute to the diversity of this type of anaesthesia. The amount of the neural blockade brought on by spinal anaesthesia is determined by the distribution of local anaesthetic solutions inside the sub arachnoid space [1]. Because of its lower risk of cardiac and central nervous system toxicity, early ambulation, and early discharge with high-quality post-operative analgesia, ropivacaine is becoming more and more popular nowadays.

When administered in isobaric form, ropivacaine, a novel long-acting amino amide with lipid solubility, causes varied sensory and motor block. Isobaric ropivacaine is the pure S (-) enantiomer of ropivacaine. In comparison to isobaric ropivacaine, hyperbaric ropivacaine caused a more consistent sensory and motor block, had a quicker onset, and provided better-quality muscle relaxation.² In patients undergoing caesarean delivery, our goal is to assess the effects of isobaric and hyperbaric ropivacaine on the onset and duration of sensory and motor blockage, hemodynamic changes, and any side effects.

Materials and Methods

This prospective observational clinical study, which done from September 2021 to August 2022 at the ESIC MCH in Bihta, Patna, involved patients who had been admitted for elective caesarean deliveries.

Patients from both groups provided informed consent in writing, and the trial was carried out in the hospital with the assistance of a specialist anesthesiologist. 80 individuals between the ages of 21 and 30 who fall under ASA physical status 1 and 2 have been scheduled for spinal anaesthesia during an elective Caesarean birth. Two groups of 40 patients each are created from these patients.

Group I: This group of patients received 2ml of 0.75% Isobaric Ropivacaine (isobaric group)

Group H: This group of patients received 2 ml of 0.75% hyperbaric Ropivacaine in dextrose 80mg/ml (Hyperbaric group).

Patients between the ages of 21 and 30 with ASA physical status 1&2 have been included for elective caesarean delivery and those who suffer from severe systemic diseases, metabolic abnormalities, neurological, congenital or cardiovascular conditions, coagulation issues, Localized infection and an allergy to local anaesthetics were excluded in this study.

A thorough pre-anesthesia checkup was performed, including history taking, clinical examination, systemic evaluation of the cardiovascular, pulmonary, and central nervous systems, as well as an examination of the spine for deformity and infection. airway evaluation completed. Basic laboratory tests were performed. The patient's family members gave their written approval after receiving full information. Prior to surgery, patients were maintained on a fast for 6 hours for solids and 2 hours for fluid clearance. The spinal anaesthetic method was described, and the patient was instructed to contact the anesthesiologist if they felt any pain or discomfort while undergoing surgery. A line was set up for

intravenous access in the operating room. All subjects had baseline values for their heart rate, systolic blood pressure, diastolic blood pressure, respiratory rate, and arterial oxygen saturation. Within 20 to 30 minutes, each patient received 10 ml/kg of ringer lactate solution as preload. Under stringent aseptic conditions, a 25G quincke's babcock's spinal needle was used to execute a subarachnoid block at the level of the L3–4 intervertebral space while the patient was seated. After injecting 1ml of 2% lignocaine under the skin, the spinal blocks were carried out using the midline method. 15 seconds were spent injecting the test substance. The patient was placed in the supine posture after the subarachnoid block. Intraoperative measurements of HR, SBP, DBP, RR, and SPO2 were taken at 3-minute (min) intervals for the first 30 minutes following the spinal solution injection, and then every 5 minutes for the next 60 minutes, and finally every 15 minutes for the duration of the procedure. Bradycardia was

treated with 0.6mg of atropine, while hypotension (MAP <60mm Hg) was treated with fluid boluses and a 6mg intravenous bolus of mephenteramine. If the SPO2 dropped below 90%, all patients received additional oxygen via facemask at a rate of 6 l/min.

Statistical Analysis

A Microsoft Excel spreadsheet was filled out with unprocessed data. It was necessary to compare qualitative and quantitative data using appropriate statistical tests, which were carried out using SPSS 17A and openepi.com. The quantitative data were given as mean and standard deviation, whereas the qualitative data were provided as numbers and percentages. T-tests were employed to examine variations between the two groups. Analyzing hypotension, bradycardia, pruritis, nausea, vomiting, and urine retention with the chi square test.

Consideration of p values: <0.05 = significant and >0.05 = Not significant.

Results

Table 1: Age and ASA grade distribution in both groups

Age group in years	Isobaric group	Percentage	Hyperbaric group	Percentage
20-24	18	45%	18	45%
25-29	20	50%	19	47.5%
>30	2	5%	3	7.5%

Total	40	100%	40	100%
Mean and SD	25.1±2.71		24.825±2.72	
ASA grade				
I	35	87.5%	30	75%
II	5	12.5%	10	25%

There is no significance between 2 groups on demographic data.

Table 2: Variables distribution in both groups

Parameters	Isobaric group	Hyperbaric group
Height	159.7±2.78	159.7±2.78
Weight	71.35±9.58	71.35±9.58
Duration of surgery	71.8±9.02	72.2±9.35

There is no significance between 2 groups on height, weight and duration of surgery.

Table 3: Level of highest sensory block in both groups

Level of highest sensory block	Isobaric group	Percentage	Hyperbaric group	Percentage	P value
T4	10	25%	20	50%	0.06
T6	27	67.5%	18	45%	
T8	3	7.5%	2	5%	
Total	40	100%	40	100%	

Level of highest sensory block is highest at T6 followed by T4 and T8 levels.

Table 4: Block characteristics in both groups

Parameters	Isobaric group	Hyperbaric group	P value
Time of onset of sensory block	4.22±1.32	4.625 ±1.004	0.12
Time from injection to reach the highest level	12.52±2.23	10.175±1.059	<0.0000001
Time of 2 segment regression from highest sensory level	98.72±5.87	79.025 ± 5.42	<0.0000001
Time for sensory regression	149.55±2.06	154.025±7.95	0.0009
Time for onset of modified bromage	12.275±1.01	7.925±0.655	<0.0000001
Time to reach modified bromage	3.275±0.98	2.5±0.506	0.00002

There is significant difference in both groups at time from injection to reach highest level, sensory regression, Time for onset of modified bromage and modified bromage.

Table 5: Comparison of systolic and diastolic blood pressure in both groups

TIME	Isobaric group	Hyperbaric group	P Value
Systolic blood pressure			
0 min	124±5.78	125±7.53	0.5
3 min	117.15±9.94	120.55±8.32	0.1
6 min	116.7±7.75	118.9±7.33	0.19
9 min	113.625±12.59	117.47±10.43	0.14
12 min	117.675±7.50	118.925±7.32	0.45
15 min	117.375±6.57	120.4±6.82	0.04**
18 min	118.625±6.09	120.225±6.90	0.2
21 min	118.25±7.02	121.025±6.55	0.07
24 min	119.375±7.17	121.525±6.32	0.15
27 min	119.075±7.80	120.825±6.25	0.27
30 min	119.45±7.24	120.8±6.08	0.36
35 min	118.95 ± 6.675	120.975±6.082	0.16
40 min	119.4±6.34	121.45±6.45	0.17

45 min	118.975±7.10	121.55±7.22	0.11
50 min	119.25±7.55	121.775±6.806	0.12
55 min	118.65±7.49	122.2±6.70	0.02**
60 min	119±7.65	122.325±6.30	0.03**
65 min	118.875±6.93	121.275±6.27	0.1
70 min	119.2±6.8	121.15±6.56	0.1
75 min	120.15±6.58	121.775±6.212	0.25
90 min	120.625 ± 6.355	120.3±6.14	0.81
105 min	121.2±6.85	120.2±5.86	0.48
120 min	121.175±6.67	120.6±6.23	0.69
Diastolic Blood pressure			
0 min	77.1±5.66	77.45±5.83	0.78
3 min	72.675±8.069	75.05±5.45	0.12
6 min	72.9±5.744	73.85±5.70	0.46
9 min	70.275±8.459	71.35±9.22	0.58
12 min	72.95±5.76	72.55±4.83	0.73
15 min	72.9±5.23	73.625±3.89	0.48
18 min	73.4±4.29	74.15±4.39	0.44
21 min	74.025±4.69	75.075±4.60	0.31
24 min	74.85±5.72	75.9±4.61	0.36
27 min	74.85±5.95	75.75±5.45	0.48
30 min	74.8±5.8	75.55±5.38	0.55
35 min	73.675±4.46	75.6±4.77	0.06
40 min	73.775±5.46	76.35±5.17	0.03**
45 min	74.4±5.62	75.875±5.65	0.24
50 min	74.2±6.022	76.3±5.57	0.1
55 min	74.15±6.074	76.6±5.15	0.05
60 min	73.97±5.88	76.025±5.126	0.09
65 min	73.8±5.25	75.7±4.92	0.09
70 min	74.35±5.48	75.75±4.39	0.211
75 min	74.225±5.70	76.3±5.20	0.09
90 min	75.52±5.74	75.475±4.72	0.96
105 min	76.625±5.62	75.75±4.98	0.46
120 min	75.875±5.56	76.05±5.72	0.89

At 15 minutes, 55 minutes, and 60 minutes following subarachnoid block, mean systolic blood pressure recordings in the hyperbaric group were higher than those in the isobaric group. At 40 minutes after subarachnoid block, the mean diastolic blood pressure recorded in the hyperbaric group was higher than in the isobaric group. When compared to the isobaric group, the hyperbaric group's mean arterial pressure recordings at 35, 40,

55, 60, and 65 minutes after subarachnoid block were higher. Additionally, the remaining intraoperative period does not show any discernible difference. During the intraoperative time, there is no discernible difference between the two groups in terms of heart rate, respiratory rate, or oxygen saturation.

Discussion

For patients undergoing lower abdomen surgery, spinal anaesthesia is a common, safe, affordable, simple-to-use, and successful approach that provides quick and dependable anaesthesia with muscle relaxation [3]. The local anaesthetics lignocaine, bupivacaine, levobupivacaine, and ropivacaine are some of the more popular ones used for spinal anaesthesia [3]. Nowadays, ropivacaine is becoming more and more popular because of its lower risk of cardiac and central nervous system toxicity, early discharge, and high-quality postoperative analgesia.

In theory, hyperbaric ropivacaine would cause more consistent sensory and motor block, with a faster onset and greater quality of muscle relaxation than isobaric ropivacaine. Isobaric ropivacaine is the pure S (-) enantiomer of ropivacaine, a novel long-acting amino amide with decreased lipid solubility. In order to compare isobaric and hyperbaric ropivacaine for spinal anaesthesia in patients undergoing lower abdominal surgery, this study was created. The current study compares the intraoperative features and recovery profile of ropivacaine administered in isobaric and hyperbaric solutions after caesarean birth.

A comparison between isobaric and hyperbaric solutions of ropivacaine has revealed that the latter causes a more consistent block with a higher success rate and a lower incidence of intraoperative pain than the former. A faster spread to a higher median dermatomal level and less variance in the maximum height of the sensory block were the results of the addition of glucose 80 mg/ml. For two reasons, we decided to use a 80 mg/ml dextrose content in the hyperbaric fluid.

First, a prior investigation by Whiteside *et al.* [4] showed the clinical effectiveness of a

ropivacaine solution containing 50 mg/ml of glucose.

Second, earlier studies with bupivacaine by Bannister *et al* [5] have revealed that glucose concentrations as low as 8.3%, which are present in the commercially available hyperbaric solution, may be adequate to provide the benefits over plain solutions that have been previously mentioned.

When a local anaesthetic solution is injected into the left lateral region of the body, gravity is likely to encourage the solution to spread down the slopes of the lumbar curve. This results in a more even distribution of the local anaesthetic solution when the patient is placed supine after the injection. An isobaric solution, on the other hand, wouldn't have this gravity-assisted distribution and would instead concentrate in the lower lumbar regions. This would explain why the block for abdominal surgery was less reliable but why the sensory and motor block in the lower limbs persisted due to the intense lumbar and sacral segment blockade.

In line with other research, our investigation found that the isobaric solution of local anaesthetic caused a sensory block that spread erratically; the highest degree of sensory block varied greatly, reaching the T8 dermatome in 3 individuals (7.5% of the isobaric group). Additionally, this is consistent with the findings of Khaw *et al.* [6], who reported that all patients in the hyperbaric group had adequate analgesia for Caesarean section. According to an earlier study by Kallio *et al* [7], the median cephalad spread of (15 mg) ropivacaine was T4 in the hyperbaric group and T9 in the plain group, respectively. As a result, when compared to the isobaric group, the cephalic distribution of sensory block with hyperbaric ropivacaine T4 was much larger.

Whiteside *et al.* 4 evaluated hyperbaric ropivacaine 15 mg and observed a median maximum cephalic spread of sensory block at T7 dermatome, which is a little less than but equivalent to our work with hyperbaric ropivacaine 15 mg T4.

Time of commencement of sensory blockage in our investigation was 4.22 ± 1.32 min in the isobaric group and 4.625 ± 1.004 min in the hyperbaric group, indicating that there was little difference between the two groups, which was consistent with Rajini Gupta *et al.* [8] study results. Similar to the Rajini Gupta *et al.* [8] study, it took the isobaric group 12.52 minutes and the hyperbaric group 10.17 minutes to reach the greatest level of sensory blockage, respectively.

Regression of the sensory block to the T10 level took 98.72 minutes in our investigation, compared to 115.8 minutes in an earlier trial by Chung *et al.* [9] using a somewhat lower dose of hyperbaric ropivacaine (18 mg). With hyperbaric ropivacaine, the median time to 2 segment regression of sensory block was shorter (79.025 min) than with conventional ropivacaine (98.72 min).

These results were consistent with those of Kallio *et al.* [7] who discovered that the median times for 2 segment regression of sensory block with 15mg ropivacaine were 90 minutes and 60 minutes, respectively, in the plain and hyperbaric ropivacaine groups. Patients in the hyperbaric group mobilised more quickly due to faster recovery from sensory and motor block and an increase in the beneficial duration of sensory block. Similar results were also seen in two earlier investigations by Kallio *et al.* [7] who found that hyperbaric ropivacaine spinal anaesthesia was linked to earlier mobilisation and quicker discharge periods.

At 15 minutes, 55 minutes, and 60 minutes following subarachnoid block, mean systolic blood pressure recordings in the hyperbaric group were higher than those in the isobaric group. At 40 minutes after subarachnoid block, the mean diastolic blood pressure recorded in the hyperbaric group was higher than in the isobaric group. When compared to the isobaric group, mean arterial pressure recordings from the hyperbaric group were higher 35, 40, 55, 60, and 65 minutes after subarachnoid block.

Additionally, the remaining intraoperative period does not show any discernible difference. During the intraoperative time, there is no discernible difference between the two groups in terms of heart rate, respiratory rate, or oxygen saturation. The hemodynamics of the two groups in the operating room and the recovery room were the same in the study by Puneeth Dwivedi *et al.* Only 4 patients out of 40 in group A (isobaric ropivacaine) experienced hypotension, while 2 patients experienced bradycardia. Only 5 out of 40 patients in group B (hyperbaric ropivacaine) experienced hypotension, while 3 patients experienced bradycardia. According to procedure, sympathomimetics or anticholinergics were given to patients in both groups in the operating room.

Conclusion

In comparison to isobaric ropivacaine, which is needed for day care surgery where prolonged immobilisation is desired, hyperbaric ropivacaine produced a more consistent, dependable, and good quality of motor block with quicker onset, early mobilisation, and rehabilitation. The results of the current investigation show that there was no discernible change in the timing of the start of sensory block. When compared to the hyperbaric group (Group-H), the time from injection to the height of the sensory

block is much longer in the isobaric group (Group-I). In comparison to isobaric ropivacaine, hyperbaric ropivacaine had more fast onset, more widespread, but less varied effects. In the isobaric group compared to the hyperbaric group, the time of two segment sensory decline from the greatest sensory level is longer.

In the isobaric group, modified Bromage grade 3 takes longer to manifest than in the hyperbaric group. Because the rate of motor regression is quicker in the hyperbaric group than in the isobaric group, patients in the hyperbaric group can be mobilised earlier than those in the isobaric group. Systolic blood pressure, diastolic blood pressure, mean arterial pressure, heart rate, respiratory rate, and peripheral oxygen saturation are not significantly different between the two groups during the intraoperative time.

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