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Original Research Article

COMPARATIVE EVALUATION OF HYPERBARIC BUPIVACAINE VERSUS HYPERBARIC ROPIVACAINE ON HEMODYNAMIC PARAMETERS DURING CAESAREAN SECTION UNDER SPINAL ANESTHESIA: AN INSTITUTIONAL BASED STUDY

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ABSTRACT

Background: Caesarean delivery is a major surgical intervention performed with hyperbaric bupivacaine emerging as the most commonly used drug for spinal anesthesia for C-section. Hyperbaric Ropivacaine is nearly identical to hyperbaric bupivacaine in and hence; the present study was conducted for comparative evaluation of hyperbaric bupivacaine versus hyperbaric ropivacaine on hemodynamic parameters during caesarean section under spinal anesthesia.

Materials and Methods: Forty ASA II women at 37–42 weeks gestation undergoing elective caesarean delivery under spinal anesthesia received either 15 mg hyperbaric ropivacaine 1% or 10 mg hyperbaric bupivacaine 0.5%. Sensory and motor blocks, pain scores, and hemodynamic parameters were monitored up to 180 minutes and analyzed using SPSS version 25.

Results: The onset of sensory and motor blocks was significantly faster in the hyperbaric bupivacaine group compared to the hyperbaric ropivacaine group. Similarly, the time to complete sensory block was significantly shorter in the hyperbaric ropivacaine group, highlighting notable pharmacodynamic differences between the drugs. HR, systolic and diastolic blood pressure change significantly during time, and also the trend of changes is almost similar in both hyperbaric ropivacaine and hyperbaric bupivacaine groups.

Conclusion: Hyperbaric ropivacaine and hyperbaric bupivacaine are both effective agents for anesthesia during caesarean delivery; however, hyperbaric ropivacaine offers advantages owing to its minimal impact on hemodynamic stability and its shorter sensory and motor block durations.

Keywords: Hyperbaric Bupivacaine, Hyperbaric Ropivacaine.

INTRODUCTION

Caesarean delivery, commonly referred to as a C-section, is a major surgical intervention performed to deliver a fetus by creating incisions through both the abdominal wall (laparotomy) and the uterine wall (hysterotomy). This approach bypasses the vaginal route of childbirth and is employed in various clinical scenarios where vaginal delivery poses risks to the mother, the fetus, or both.[1] Over the centuries, advancements in surgical techniques, anesthesia, antisepsis, and perioperative care have transformed the safety and outcomes of this procedure.[2] In modern obstetric practice, caesarean delivery has become one of the most frequently performed surgeries worldwide. In the United States alone, it is the leading operative procedure for women, with more than one million cases conducted each year. This high prevalence reflects both medical indications—such as fetal distress, abnormal presentations, placenta previa, and previous uterine surgeries—and non-medical factors, including

maternal request and medicolegal considerations. The continued evolution of surgical methods, coupled with improved postoperative recovery protocols, has significantly enhanced maternal and neonatal survival, making caesarean delivery a cornerstone of contemporary obstetric care.[3-5] Hyperbaric bupivacaine has emerged as the most commonly used drug for spinal anesthesia. However, since it has undesirable effects such as hypotension, bradycardia, prolonged duration of motor paralysis, cardiotoxicity and central nervous system toxicity, there led to the identification of long acting pure S-enantiomer of hyperbaric ropivacaine. Hyperbaric ropivacaine is nearly identical to hyperbaric bupivacaine in onset, quality and duration of sensory block, but it produces lesser duration of motor blockade, has a better safety profile.[6] Hence; the present study was conducted for comparative evaluation of hyperbaric bupivacaine versus hyperbaric ropivacaine on hemodynamic parameters during caesarean section under spinal anesthesia.

MATERIALS AND METHODS

40 women scheduled for elective caesarean delivery under spinal anesthesia were enrolled. Eligible patients were 37–42 weeks pregnant, ASA Class II; exclusions included pre/post-term delivery, emergency cases, fetal abnormalities, analgesic allergy, or spinal anesthesia contraindications. Participants were randomized to receive either 15 mg hyperbaric ropivacaine 1% or 10 mg hyperbaric bupivacaine 0.5%, administered in the sitting position at L3–L4 or L4–L5. Sensory block was assessed via pinprick and motor block using a modified Bromage scale at 5-minute intervals for 60 minutes, then up to 180 minutes, with pain intensity measured by visual analog scale (VAS). All the patients were monitored for 24 hours postoperatively. Blood pressure was recorded every 5 minutes for 30 minutes, then every 15 minutes. Baseline systolic/diastolic pressures and heart rate were documented before injection. All the results were compiled in Microsoft excel sheet and were subjected to statistical analysis using SPSS software version 25.

RESULTS

The mean age, gestational age, height, weight, and duration of surgery were comparable between the two groups, indicating adequate matching of baseline parameters. The onset of sensory and motor blocks was significantly faster in the hyperbaric bupivacaine group compared to the hyperbaric ropivacaine group ($p = 0.0012$ and $p = 0.0290$, respectively). Similarly, the time to complete sensory block was significantly shorter in the hyperbaric ropivacaine group ($p = 0.0018$), highlighting notable pharmacodynamic differences between the drugs. The hyperbaric ropivacaine group had a slightly lower mean pain score compared to the hyperbaric bupivacaine group; however, this difference was not statistically significant ($p = 0.223$), indicating comparable postoperative analgesia. At baseline (0 min) and up to 40 minutes, heart rates in both groups were comparable, with no statistically significant differences ($p > 0.05$). From 60 minutes onward, both groups demonstrated a gradual decline in heart rate, maintaining similar values at 120 and 180 minutes without significant differences. The systolic and diastolic blood pressure change significantly during time, and also the trend of changes is almost similar in both hyperbaric ropivacaine and hyperbaric bupivacaine groups.

Table 1: Demographic and clinical data

Parameter	Hyperbaric Ropivacaine (Mean)	Hyperbaric Bupivacaine (Mean)
Age (years)	28.1	28.5
Gestational age (weeks)	38.5	38.1
Height (cm)	162.3	163.1
Weight (kg)	75.1	76.2
Duration of surgery (min)	8.2	9.3

Table 2: Demographic and clinical data

Variable	Hyperbaric Ropivacaine (Mean)	Hyperbaric Bupivacaine (Mean)	P-Value
Onset of sensory block (min)	2.53	1.44	0.0012*
Time to complete sensory block (s)	141.9	182.3	0.0018*
Onset of motor block (min)	2.95	1.52	0.0290*

**: Significant*

Table 3: Comparison of pain

Pain	Hyperbaric Ropivacaine (Mean)	Hyperbaric Bupivacaine (Mean)
Mean	1.23	1.38
SD	0.28	0.51
p-value	0.223	

Table 4: Comparison of heart rate

Time (min)	Mean Heart Rate - Hyperbaric Ropivacaine	Mean Heart Rate - Hyperbaric Bupivacaine	p-value
0	81.3	80.7	0.25
5	83.8	82.2	0.31
10	85.2	85.7	0.81
30	80.9	86.2	0.16
40	82.8	87.9	0.33
50	79.1	82.1	0.82
60	71.5	76.5	0.21
120	70.3	71.8	0.82
180	70.7	72.3	0.97

DISCUSSION

Caesarean section delivery is the most important operation in obstetrics, and its incidence is on the rise throughout the world. It is one of the most commonly performed major surgeries in obstetric practice intended to save the mother and child, in turn, reducing the maternal and perinatal mortality. The steadily increasing global rate of caesarean section has become one of the most debated topics in maternity care as its prevalence has increased alarmingly in the last few years.[7-10]

In the present study, the onset of sensory and motor blocks was significantly faster in the hyperbaric bupivacaine group compared to the hyperbaric ropivacaine group ($p = 0.0012$ and $p = 0.0290$, respectively). Similarly, the time to complete sensory block was significantly shorter in the hyperbaric ropivacaine group ($p = 0.0018$), highlighting notable pharmacodynamic differences between the drugs. The hyperbaric ropivacaine group had a slightly lower mean pain score compared to the hyperbaric bupivacaine group; however, this difference was not statistically significant ($p = 0.223$), indicating comparable postoperative analgesia. At baseline (0 min) and up to 40 minutes, heart rates in both groups were comparable, with no statistically significant differences ($p > 0.05$). From 60 minutes onward, both groups demonstrated a gradual decline in heart rate, maintaining similar values at 120 and 180 minutes without significant differences. The systolic and diastolic blood pressure change significantly during time, and also the trend of changes is almost similar in both hyperbaric ropivacaine and hyperbaric bupivacaine groups. In a previous study conducted by Olapour et al, authors comparing clinical efficacy and safety between ropivacaine and bupivacaine during caesarean section. 65 women were randomly allocated to receive either ropivacaine 1% (n = 33) or bupivacaine 0.5% (n = 32). Afterwards, the differences in the anesthetic efficacy, vital signs, and hemodynamics of participants between the two groups were recorded. Duration of sensory block was shorter in the ropivacaine group than bupivacaine group (132.5 ± 21.6 min vs. 175.8 ± 26.2 min; $P < 0.001$). Ropivacaine also produced a shorter duration of motor blockade than bupivacaine (124.8 ± 20.2 min vs. 168.2 ± 21.7 min; $P < 0.001$). There is no difference between the two groups in terms of systolic and diastolic blood pressure, but the heart rate of patients in the bupivacaine group is significantly higher than the ropivacaine group.[10]

Danelli G et al compare clinical efficacy and safety of ropivacaine and bupivacaine given intrathecally in combination with morphine for caesarean delivery. 60 women scheduled for elective caesarean delivery under spinal anesthesia were randomly allocated to receive spinal anesthesia with either 20 mg ropivacaine plus 0.1 mg morphine (n = 30) or 15 mg bupivacaine plus 0.1 mg morphine (n = 30). Profile of spinal block (onset and recovery times), cardiovascular effects, and quality of postoperative analgesia (patient-controlled morphine) were recorded by a blinded observer. The onset time of motor block was shorter after bupivacaine (8 +/- 2 min) than after ropivacaine (12 +/- 5 minutes) ($P < .05$), whereas duration of both sensory and motor blocks was longer after bupivacaine (139 +/- 37 minutes and 254 +/- 76 minutes) than after ropivacaine (112 +/- 27 minutes and 211 +/- 48 minutes) ($P < .01$ and $P < .05$, respectively). No differences in intraoperative quality of anesthesia and clinical hypotension requiring ephedrine administration were observed between the two groups. Postoperative analgesia was similarly effective in both groups; however median consumption of patient-controlled morphine during the first 24 hours after surgery was higher in patients of group Ropivacaine (5 mg; range, 0 to 18 mg) than in patients of group Bupivacaine (2 mg; range, 0 to 7 mg) ($P < .01$). Spinal anesthesia produced with 20 mg ropivacaine plus 0.1 mg morphine is as effective and safe as that provided by 15 mg bupivacaine plus 0.1 mg morphine, with an earlier recovery of sensory and motor functions after surgery.[11]

CONCLUSION

Hyperbaric ropivacaine and hyperbaric bupivacaine are both effective agents for anesthesia during caesarean delivery; however, hyperbaric ropivacaine offers advantages owing to its minimal impact on hemodynamic stability and its shorter sensory and motor block durations, which facilitate faster recovery and enhance patient safety.

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