ORIGINAL ARTICLE

COMPARISON OF HEMODYNAMIC EFFECT CAUSED BY INTRATHECAL LOW DOSE ADMINISTRATION OF 0.5% AGAINST 0.75% HYPERBARIC BUPIVACAINE IN PATIENTS UNDERGOING LOWER LIMB SURGERY UNDER UNILATERAL SPINAL ANAESTHESIA

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Background: Spinal anaesthesia has its unique place in modern anaesthetic practice. In past, most of the surgeries, irrespective of the site of surgery, were performed in general anaesthesia but now in the modern anaesthetic field, spinal anaesthesia has markedly replaced general anaesthesia, specifically in obstetrics, lower limbs, and abdominal surgeries. **Methods:** A total of 100 patients fit to undergo lower limb surgery between the ages of 20 to 70 years were included in the study. 50 patients were in 0.5% hyperbaric bupivacaine (Group A) while 50 patients were in the 0.75% hyperbaric bupivacaine group (Group B). Patients with a history of allergies to local anaesthetics, ischemic heart disease and contraindications to spinal anaesthesia were excluded. At the end of the injection, the patient was immediately laid down and tilted to 30 degrees lateral on the operative side for unilateral anaesthesia. Mean arterial pressure at baseline, 15, 30, 45 and 60 minutes was recorded by trainee anaesthesia. A baseline was taken of mean arterial pressure measured 15 minutes before induction of spinal anaesthesia in a lying position. **Results:** The mean baseline arterial pressure of patients in group A was 88.72±1.71 mmHg and in group B was 88.94±1.95 mmHg. Mean arterial pressure MAP at 15, 30, 45 and 60 minutes in both groups was as follows; 86.22±2.55 vs 81.78±1.52 mmHg, 83.72±3.36 vs 75.84±1.34 mmHg, 80.02±3.40 vs 70.90±0.97 mmHg and 77.14±4.24 vs 66.06±1.62 mmHg respectively (p-value <0.05). **Conclusion:** This study concluded that the hemodynamic parameters in terms of mean arterial pressure remained more stable by deviating less from the baseline value with the use of a low dose of 0.5% hyperbaric bupivacaine instead of 0.75% hyperbaric bupivacaine in patients undergoing lower limb surgery under unilateral spinal anaesthesia.

Keywords: Hyperbaric bupivacaine; Mean arterial pressure; Unilateral spinal anaesthesia

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INTRODUCTION

Subarachnoid block, also known as spinal anaesthesia, is a type of regional anaesthesia believed to be a better option for patients undergoing lower abdominal surgeries, perineal surgeries, and surgeries of the lower limb than general anaesthesia, thus, avoiding life threatening complications such as failure to intubate[1], reintubation in operating room or recovery room due to inadequate reversal of neuromuscular blockers[2] or overdose of opioids and aspiration of gastric contents[3].

For lower limb procedures, anaesthetic techniques such as general anaesthesia, central neuraxial blocks, peripheral nerve blocks, intra-articular local anaesthesia, and others are available. Most surgical operations on the lower limbs involve unilateral spinal anaesthesia. This approach has various advantages, including fewer hemodynamic changes, reduced urinary retention, patient' satisfaction, improved motility after recovery, and the limitation of a selective nerve block to the appropriate limb. Spinal anaesthesia is preferable over general anaesthesia for several reasons, including hemodynamically stable vitals, less postoperative discomfort, less blood loss, faster recovery, less postoperative deep venous thrombosis, and less postoperative delirium. It is commonly used as a sole type of anaesthesia to carry out lower limb surgeries nowadays worldwide.[4] Despite all the advantages mentioned above, sympathetic block induced by spinal anaesthesia may result in hypotension, bradycardia, dysrhythmias, and cardiac arrest. Hypotension is the most common complication of spinal anaesthesia. The major mechanism responsible for hypotension following spinal anaesthesia is sympatholysis resulting in a decrease in systemic vascular resistance and vasodilation resulting in a decrease in cardiac output. As compared to conventional spinal anaesthesia, unilateral spinal anaesthesia produces less hypotension, prolonged

analgesia, less incidence of failure and faster onset of action. It limits the distribution of the spinal block to the operated side.[5]

According to a local study done by Rani *et al* in 2019 at Mayo Hospital Lahore, a high intrathecal dose that is 15 mg of hyperbaric 0.5% and 15 mg of hyperbaric 0.75% bupivacaine produced no significant effect on mean arterial pressure in patients undergoing elective surgery under conventional spinal anaesthesia.[6] However, in 2017, another local study done by Rai *et al* in CMH Multan showed that pregnant females undergoing elective caesarean section and receiving a conventional dose (15 mg) of spinal anaesthesia with 0.5% versus 0.75% hyperbaric bupivacaine had statistically significant difference hemodynamically with the group of patients receiving 0.75% hyperbaric bupivacaine experiencing more hypotension.[7] Similar results were also observed by Iftikhar et al in a local study done in CMH Malir in 2020.[8] Therefore, this study is conducted to see the effect of low doses (7.5 mg) of different concentrations (0.5% and 0.75%) of hyperbaric bupivacaine on the hemodynamic status of patients in the lateral position, so, as to find the ideal concentration of local anaesthetic which has less effect on patients' hemodynamic.

MATERIAL AND METHODS

This is an observational study conducted for 6 months from 1st October 2022 to 1st March 2023. After approval from the hospital ethical committee, a pre-anaesthesia assessment of all the patients was done as per institute protocol and patients were assessed for inclusion and exclusion criteria. The pros and cons of the procedure were explained and informed. Based on the 2017 study by Rai et al. and 95% confidence interval (p=0.05), the sample size was estimated to be 50 patients per group.[7] Consent was obtained from all 100 male and female patients undergoing lower limb surgeries.

On the day of surgery, standard monitoring including non-invasive blood pressure, electrocardiography and pulse oximetry was started and an intravenous line was secured. Patients were pre-loaded with 5ml/kg Ringer's lactate solution. They were then randomly allocated to Group A and Group B.

- Group A: Intrathecal 0.5% hyperbaric Bupivacaine 7.5mg (1.5ml).
- Group B: Intrathecal 0.75% hyperbaric Bupivacaine 7.5mg (1.0ml).

All patients were placed in a lateral position on the operative side, while the vertebral column was positioned as horizontally as possible. Under complete aseptic technique and after back sterilization; a dural puncture was performed using a midline approach at L3-L4 interspace with 25-gauge spinal needle. Group A received 7.5 mg of 0.5% bupivacaine while Group B received 7.5 mg of 0.75% bupivacaine after confirming the free flow of CSF. The selected dose was injected slowly. All the patients were given 2 mg midazolam intravenously and oxygen @ 2-4 L/min. Mean Arterial Pressure (MAP) at baseline, 15, 30, 45 and 60 minutes was recorded by trainee anaesthesia. A baseline was taken of MAP measured 15 minutes before induction of spinal anaesthesia in a lying position.

Before the onset of surgery, the extent of sensory block (analgesia) was determined using a 3-point rating scale: 0= Normal sensation, 1= Blunted sensation, and 2= Absent sensation. Complete sensory block was taken as a score of 2. A score of <2 was considered an incomplete sensory block. Motor block was assessed using a modified Bromage Scale whereby patients were asked to flex the limb at the hip, knee and ankle joints and the results were recorded as 0 = no motor block, 1 = hip blocked, 2 =hip and knee blocked, 3 = hip, knee and ankle blocked. Patients were maintained in a lateral position (for 15–20 minutes) and were judged ready for surgery when there was a complete loss of pinprick sensation at the T10 level of the operative side. They were then turned to a supine position.

Data was collected and analyzed using SPSS-23. Descriptive statistics were used to calculate quantitative variables. Mean and standard deviation were calculated for quantitative variables e.g., age, weight and mean arterial pressure at baseline, 15, 30, 45 and 60 minutes respectively. Frequency and percentage were computed for qualitative variables e.g., gender, American Society of Anaesthesiologists (ASA) classification grade and complications. Mean arterial pressure between the two patient groups was compared by independent sample T-test. A p-value less than 0.05 was considered significant. A Two-way ANOVA test for Repeated Measures was used to compare the effect of two different concentrations of hyperbaric bupivacaine on mean arterial pressure measurement at different time intervals, i.e., at baseline, 15, 30, 45 and 60 minutes after giving unilateral spinal anaesthesia.

RESULTS

The age range in this study was from 20 to 70 years with the mean age of patients being 62.12±3.75 years. The mean weight of patients was 71.20±3.64 kg. Fifty patients (50%) were males, and 50 patients (50%) were females. 48 patients (48%) belonged to ASA classification grade 1 while 52 patients (52%) were of ASA grade 2. See Table 1. The mean baseline arterial pressure MAP of patients in group A was 88.72±1.71 mmHg and in group B was 88.94±1.95 mmHg. Mean arterial pressure (MAP) at 15, 30, 45 and 60 minutes in both groups was as follows; 86.22±2.55 vs 81.78±1.52 mmHg, 83.72±3.36 vs 75.84±1.34 mmHg, 80.02±3.40 vs 70.90±0.97 mmHg and 77.14±4.24 vs 66.06±1.62 mmHg respectively (p-value <0.05). See Table 2. Two-way ANOVA test for repeated measures showed a

significant difference in MAP measured at different time intervals between the two groups of patients with drastic hemodynamic changes being seen more commonly in 0.75% hyperbaric bupivacaine receiving patients. See Figure 1. Complications occurring after unilateral spinal anaesthesia are shown in Table-3.

Table- 1: Mean±SD of demographic characteristics of patients. n=100

Demographics	Mean±SD	*p*-value
Age (years)	62.12±3.75	0.999
Weight (kg)	71.20±3.64	0.857
Gender (male: female)	50:50	0.579
ASA classification grade (I: II)	48:52	0.421

Table-2: Mean Arterial Pressure measured at different time intervals in both groups. n=100

Mean Arterial Pressure MAP	Mean±SD Group A n=50	Mean±SD Group B n=50	*p*-value
Baseline MAP	88.72±1.71	88.94±1.95	0.551
MAP at 15 minutes after unilateral spinal anaesthesia	86.22±2.55	81.78±1.52	0.000
MAP at 30 minutes after unilateral spinal anaesthesia	83.72±3.36	75.84±1.34	0.000
MAP at 45 minutes after unilateral spinal anaesthesia	80.02±3.40	70.90±0.97	0.000
MAP at 60 minutes after unilateral spinal anaesthesia	77.14±4.24	66.06±1.62	0.000

Table- 3: Comparison of complications in both groups. n=100

Complications	Group A n=50 (%)	Group B n=50 (%)	*p*-value
Nausea and vomiting	1 (2)	2 (4)	0.842
Bradycardia	1 (2)	1 (2)	
Hypotension	0	0	

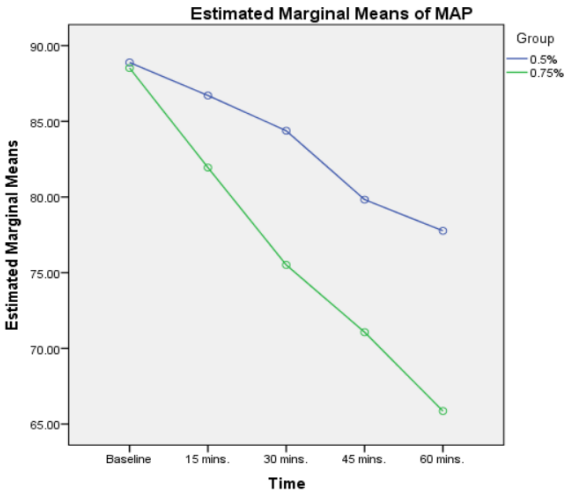

Figure-1: Plotting Mean arterial pressure measured at 0, 15, 30, 45 and 60 minutes after giving unilateral spinal anaesthesia between Group A and B patients.

DISCUSSION

Anaesthesiologists are commonly called in for treatments involving just one lower leg, particularly, in brief, orthopaedic surgeries. In comparison to normal spinal anaesthesia, unilateral spinal anaesthesia may be superior for a variety of procedures due to a lower risk of hypotension, a quicker recovery from blocking, and higher patient satisfaction.[9] Unilateral spinal anaesthesia has been proposed to be induced using lateral anaesthesia injection, low anaesthetic doses, pencil point or cutting point needle orientation, and slow injection rates. To do this, hypobaric, isobaric, and hyperbaric solutions have been used to induce unilateral spinal anaesthesia.[10]

Khatouf *et al* validated the efficacy of low intrathecal dose in unilateral spinal anaesthesia in an observational analysis of 25 patients over the age of 80 who were operated on for proximal femur fracture.[11] In our study, we used lower intrathecal dose of different concentrations of hyperbaric bupivacaine in unilateral spinal anaesthesia, so, as to compare the hemodynamic changes and their deviation from baseline value. We found that the mean arterial pressure (MAP) remained stable with lesser deviation from the initial baseline value in patients receiving 0.5% hyperbaric bupivacaine while the dose was kept the same (7.5mg) for both groups of patients.

In 1998, Esmaoglu *et al* conducted a study which validated that no hypotension was detected with the administration of 7.5 mg (1.5 ml) and 10 mg (2 ml) of 0.5% hyperbaric bupivacaine along with the establishment of effective unilateral spinal anaesthesia.[12] Similar results were observed by Casati and his colleagues while studying the effects of 0.5% hyperbaric bupivacaine in unilateral spinal anaesthesia.[13] However, Casati et al documented that hyperbaric bupivacaine solutions cause 10%[14] to 20%[15] hypotension with the use of higher concentrations such as 0.75% or 1% in unilateral spinal anaesthesia, regardless of injection rate, while studying the unilateral block's characteristics primarily. These researches lend credence to our study's conclusions while highlighting the knowledge gap that our study fills as not many studies performed unilateral anaesthesia and studied the hemodynamic status comparing two different concentrations of hyperbaric bupivacaine.

The cardiovascular effects of the neuraxial blockade and patient compensatory mechanisms, which are typically impacted by ageing and comorbidities, are both factors in perioperative hemodynamic instability. In most cases, it can be avoided by minimizing the cardiovascular effects of central neuraxial blockade. One-sided sympathetic block and dose restriction of local anaesthetics are two

easy-to-use techniques. The effectiveness of these methods has been supported by a study conducted by Casati and his colleagues in 1999. Thus, the incidence of hypotension (systolic blood pressure decrease >30% from baseline) ranges from 22.4% with a conventional supine method to 5% with unilateral spinal anaesthesia using lower concentration (0.5%) of hyperbaric bupivacaine.[16]

CONCLUSION

According to the results of this study, 7.5 mg of 0.5% hyperbaric bupivacaine stabilizes mean arterial pressure more effectively from the baseline value than 7.5 mg of 0.75% hyperbaric bupivacaine in patients undergoing lower limb surgery under unilateral spinal anaesthesia.

Limitations of study:

The use of non-probability sampling, which was ideal for our study design and sample selection because our inclusion and exclusion criteria were stringent, as well as a solid study design analysis, reduced the possibility of bias in our research. These factors made our study strong. The main limits of our study were the few outcomes we chose, which have an impact on the significance of our research, as numerous variables and factors that are related to our outcome variables may have been included in our study. Further multiple center studies are recommended regarding this clinical trial which may impact future practices and policies.

Conflict of interest: Nil.

AUTHORS' CONTRIBUTION

MKK: Conception of study/study experimentation. MKK, AH: Analysis, interpretation, discussion. MKK, FF: Write-up. AAT, SF: Critical review. MSBF: Proofreading.

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