Section: Anaesthesiology

Original Research Article

COMPARISON OF LEG WRAPPING VERSUS LEG ELEVATION TO PREVENT HYPOTENSION DURING SPINAL ANAESTHESIA FOR ELECTIVE CAESAREAN SECTION

N. Saranya Devi[1], M. Ganeshmoorthy[2], S. Maria Varun Raj[3]

[1]Assistant Professor, Department of Anaesthesiology, Government Royapettah Hospital, Government Kilpauk Medical College, Chennai, India.
[2]Assistant Professor, Department of Anaesthesiology, Government Kilpauk Medical College, Chennai, India.
[3]Assistant Professor, Department of Anaesthesiology, Government Royapettah Hospital, Government Kilpauk Medical College, Chennai, India.

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Corresponding Author:
Dr. M. Ganeshmoorthy,
Email: m.ganeshmoorthy@gmail.com.

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Abstract

Background: Hypotension after spinal anaesthesia is a prevalent adverse event often seen in patients who have undergone caesarean section. The present study aimed to compare leg wrapping and leg elevation to prevent hypotension in spinal anaesthesia for elective caesarean section. **Material & Methods:** This prospective, double-blind, randomised controlled trial was undertaken on 90 full-term pregnant patients with singleton uncomplicated pregnancies belonging to the American Society of Anaesthesiologists Class I or II, scheduled for elective caesarean section under spinal anaesthesia. All enrolled patients were allocated randomly to either Group BLW (leg wrapping) (n = 30), BLE (leg elevation) (n = 30), or BC (control). Patient demographics and haemodynamic variables were also recorded. Hypotension, ephedrine use, and other side effects were also observed. **Results:** The group's mean heart rate, spO2, and systolic blood pressure were comparable. A significant decrease in mean arterial pressure was reported in the leg elevation and control groups compared to that in the leg wrapping group in the first 20 min. The hypotension was reported to be significantly higher ($p<0.05$) in the leg-elevated group (BLE) as compared to BLW and BC group patients. Ephedrine use was found to be at its maximum in the BC group, followed by the BLE group. An insignificant side effect was reported in all three groups. **Conclusion:** We conclude that leg wrapping significantly decreases the incidence of spinal hypotension and results in a marked reduction in vasopressor agents compared with leg elevation and control groups.

INTRODUCTION

The choice of local anaesthetic is determined by the block quality required and surgery duration. In the early 1950s, lignocaine, the first amide local anaesthetic agent, was clinically used. Lignocaine has been extensively used for spinal anaesthesia since its introduction into clinical practice. Lignocaine is not used in spinal anaesthesia due to transient neurological symptoms. Bupivacaine, the first long-acting amide local anaesthetic, is the most commonly used local anaesthetic drug now.[1-2]

Spinal blockade up to T4 is necessary to provide adequate anaesthesia for caesarean section.[2] Hypotension due to sympathetic blockade is inevitable during spinal anaesthesia. Prevention of hypotension due to spinal anaesthesia for elective caesarean section has been referred to as the "Holy Grail" in obstetric anaesthesia.[3-4] Despite enormous developments in anaesthetic drugs and techniques, hypotension during spinal anaesthesia is still a major problem. Hypotension is defined as a 20% decrease in systolic blood pressure from baseline or systolic blood pressure < 90mmHg.[5]

Hypotension results in dizziness, nausea, and vomiting, which makes the experience uncomfortable for the mother. In severe cases, neuraxial block-induced hypotension can result in unconsciousness, pulmonary aspiration, apnoea, and cardiac arrest. Sustained hypotension can impair uteroplacental perfusion and thus may induce foetal hypoxia and acidosis.[6] Numerous studies have been conducted to find an ideal method for preventing spinal hypotension. Different techniques include fluid transfusion, pre-emptive and intraoperative vasopressor usage, and physical methods. Fluids, either crystalloids or colloids, increase intravascular volume and prevent hypotension.[7] This simple and

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easy technique cannot be used in gestational hypertension and cardiac patients. Colloid use is associated with a risk of allergic reactions and anaphylaxis. The role of preloading and co-loading in preventing spinal hypotension has become doubtful.[8]

Physical methods include left table tilt (12.5 to ˚to15˚) and left uterine displacement using wedge-relieved aortocaval compression and increased venous return. However, studies have proven that these techniques do not prevent hypotension significantly.[9-10] Venous pooling due to peripheral vasodilation is one of the most common reasons for hypotension in spinal anaesthesia; hence, methods such as leg compression using elastic crepe bandage, esmarch bandage, compressive stockings, and leg elevation have also been studied for their effect on the prevention of spinal hypotension.[11] These methods are simple, easy, and have better foetal outcomes and improved venous return without increasing cardiac workload; nevertheless, localised ischaemia and maternal discomfort may rarely occur. We designed this study to compare the efficacy of these two simple and promising techniques of leg wrapping and leg elevation in preventing spinal anaesthesia-induced hypotension during elective caesarean section.

MATERIALS AND METHODS

This prospective, double-blinded, randomised controlled trial was conducted after approval by the Institutional Ethical Committee. Written informed consent was obtained from each patient to participate in the study. Ninety full-term pregnant patients with singleton uncomplicated pregnancies belonging to American Society of Anaesthesiologists Class I or II, scheduled for elective caesarean section under spinal anaesthesia, were allocated randomly by lots to either Group BLW (leg wrapping) (n = 30), Group BLE (leg elevation) (n = 30) or Group BC (control). The institutional ethics committee approved this study before its initiation.

Inclusion Criteria

All patients with ASA grade 1 or 2 with single live foetuses, gestational age ≥ 37 weeks, and uncomplicated pregnancy were selected for the study.

Exclusion Criteria

Patients with reported allergy to bupivacaine and cardiovascular medications, foetal anomaly, pregnancy-induced hypertension and multiple gestations, contraindications for spinal anaesthesia, and refusal to participate in the study were excluded. Patient characteristics, including age, height, weight, and gestational age, were recorded. All patients fasted overnight before the surgery. In all patients, the intravenous line was secured using an 18-gauge cannula. All patients received an injection of ranitidine 50 mg intravenously and an injection of metoclopramide 10 mg intravenously 30 minutes before surgery.

The patient was shifted to the operation table, and standard monitors such as a pulse oximeter, non-invasive blood pressure cuff, and electrocardiogram leads were connected. The baseline blood pressure and heart rate were measured in the supine position. Intravenous fluid preloading was then performed with 20 ml/kg of ringer lactate solution over 15 to 20 min immediately before spinal anaesthesia.

Patients in the BLW group (n = 30) had their lower limbs wrapped before the subarachnoid block administration. Leg wrapping was achieved with crepe bandage (15 cm width, 4 m stretched length) applied from the ankle to the mid-thigh in both legs in turns; during wrapping, lower extremities were lifted at an angle of 45°; after wrapping, legs were placed in neutral position and covered. The crepe bandages were wrapped tightly enough that the women felt tight, yet it was comfortable and not painful. Care was taken to avoid compressing the legs to greater than arterial pressure by checking for capillary pulsation in the toes. All patients had their legs wrapped by the same person for approximately 3 minutes to eliminate bias introduced by the method or altered wrapping force. Patients in the BLE group (n=30) had their legs elevated immediately after spinal anaesthesia, such that they were at an angle of 30°to the horizontal plane and covered. Patients in group BC (n=30) had neither raised nor wrapped lower limbs but were covered.

Statistical Analysis

The collected information was recorded on a master chart. Data entry was performed using IBM SPSS Statistics for Windows version 22. The collected data were analysed using a statistical package for the social sciences. Analysis of variance with post hoc test for demographic and clinical data and 2 × 2 chi-square test for the incidence of hypotension were used to test the significance. Statistical significance was set the statistical significance.

RESULTS

Parturients with uncomplicated singleton pregnancies at gestational age were included in the study. Demographic variables, such as age, weight, height, and gestation, were comparable among all three groups of patients. [Table 1]

Clinical parameters such as time from spinal to delivery of the baby, time from delivery to the end of the surgery, total duration of surgery, maximum cephalic sensory block level, and time to maximum sensory block level were evaluated and found to be comparable among all groups. [Table 2]

All patients were monitored, and haemodynamic variables, such as heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and oxygen saturation, were noted every 2 min for up to 20 min and every 5 min for up to 60 min. The group's mean heart rate, spO2, and systolic blood

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pressure were comparable. In comparison, there was a significant decrease in mean arterial pressure reported in the leg elevation and control groups compared to the leg wrapping group in the first 20 min. There was a slow rise in mean arterial blood pressure using ephedrine in the leg elevation and control groups. [Figures 1-4]

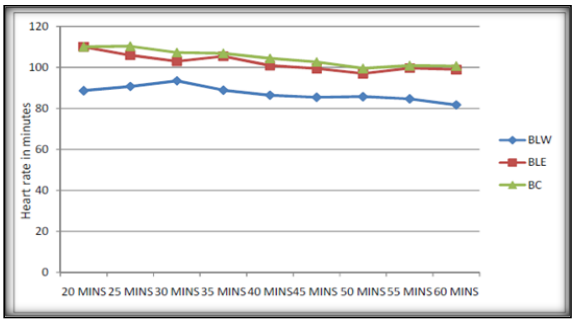

Figure 1: Heart rate between the three groups

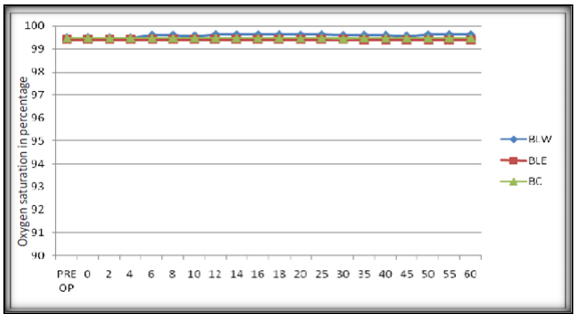

Figure 2: SpO2 between the three groups

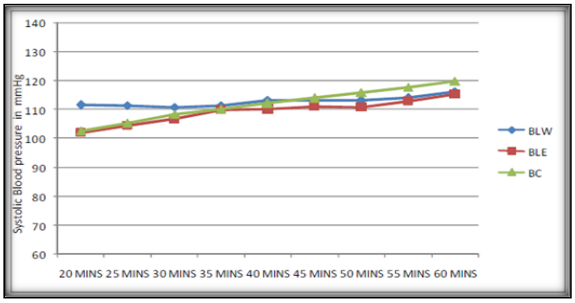

Figure 3: Systolic blood pressure between the three groups

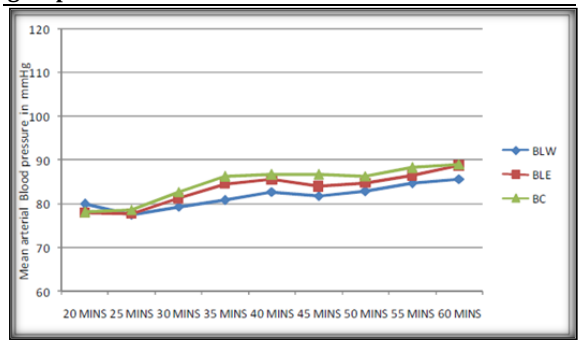

Figure 4: Mean arterial pressure between the three groups

The blood pressure in the leg-wrapped group (BLW) was stable, with a decrease in blood pressure noted in 3(10%) patients, compared to 10 (33.33%) patients in the leg-elevated group (BLE) and 15 patients in the control group (BC). The difference in the occurrence of hypotension between the study groups was statistically significant ($p < 0.05$). [Table 3] Ephedrine use among the groups was also studied. In the leg-wrapped group, ephedrine usage was 6 mg in three patients. In the leg elevation group, ephedrine usage was 6 mg in 7 patients and 12 mg in 3 patients, and in the control group, 6 mg in 7 patients, 12 mg in 5 patients, 18 mg in two patients and 2 mg in one patient.

During this study, the patients were observed for any untoward side effects, such as nausea, vomiting, bradycardia, and dyspnoea. In the leg-wrapped BLW group, one patient experienced nausea. In the leg elevation BLE group, two patients had nausea, five patients had nausea, and two patients had vomiting. None of the patients vomited in the BLW or BLE groups. This was not statistically significant. Similarly, none of the three groups had bradycardia or dyspnoea.

Table 1: Observation of demographic variables among patients of all groups

Variables	Mean± SD			P-value
	BLW	BLE	BC	
Age (years)	25.2±3.7	25.9±3.8	24.3±3.9	0.279
Weight (kg)	57.7±4.3	58.1±4.1	58.1±3.8	0.923
Height (cm)	149.9±5.4	150.8±4.5	151.2±4.4	0.600
Gestation Age (weeks)	37.6±0.7	37.8±0.6	37.6±0.6	0.394

Table 2: Observation of Clinical parameters among patients of all groups

Variables	Mean± SD			P-value
	BLW	BLE	BC	
Time from spinal to delivery of baby (min)	7.17±0.83	7.20±0.66	7.27±0.52	0.848
Time from delivery to end of surgery (min)	40.50±2.78	41.90±3.78	40.63±2.83	0.174
Total duration of surgery (min)	47.67±2.65	49.10±3.71	47.90±2.90	0.169
Maximum cephalic sensory block level	T5(T4-T6)	T5(T4-T6)	T5(T4-T6)	-
Time to maximum sensory block level(min)	3.13±0.81	3.17±0.74	3.27±0.52	0.750

Table 3: Comparison of incidence of hypotension among all group patients

GROUPS	BLW (3) + BLE (10)	BLW (3) + BC (15)	BLE (10) + BC (15)
Chi-Square value	4.8118	11.428	1.714

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P value	0.0282 (<0.05)	0.0007 (< 0.05)	0.19 (>0.05)
SI	Significant	Significant	Insignificant

DISCUSSION

In our study, 90 parturients were randomly assigned to BLW (n=30), BLE (n=30), and BC (n=30). The demographic data of the patients were comparable. There were no significant differences among the three groups when comparing age, weight, height, and gestational age. We administered bupivacaine at a dose of 0.06 mg/cm of height. Singh et al. used 2.5ml of 0.5% hyperbaric bupivacaine for all patients in their study.[12] We chose to use dosage according to height because the mean height in their study was 164 cm, but our study was conducted in south India, where the average height was 152 cm for females.

In our study, the mean height was 149.97 cm in the BLW group, 150.83 cm in the BLE group and 151.20 cm in the BC group. Maximum spinal block level, time to reach maximum block, time from spinal block to delivery of baby, time from delivery to end of surgery, and total duration of surgery were comparable among all groups. Leg elevation did not influence the maximum block level or time to achieve the maximum block level. In a study conducted by Rout et al., they also concluded that leg elevation to 30˚ had not influenced block height.[13]

The incidence of hypotension in the leg-wrapped group (BLW) was three patients (10%), whereas in the leg-elevated group (BLE), ten patients (33.33%) had hypotension [p =0.0282] and 15 patients (50%) in the control group (BC) (50%) [p =0.007]. This observation implies that leg wrapping significantly prevents spinal hypotension compared to leg elevation and the control group. Leg elevation did not significantly reduce hypotension incidence. The requirement for rescue ephedrine was lower in the leg-wrapped group (BLW). They required only a single dose of 6 mg intravenously, whereas, in the leg elevation group (BLE), rescue ephedrine was 12 mg IV; in the control group (BC), the ephedrine requirement was 18 to 24 mg IV. Thus, the ephedrine requirement was significantly lower in the leg wrapping group (BLW) than in the leg elevation and control groups. Bhagwanjee et al., in their study, also found that the incidence of hypotension was significantly less in the leg-wrapped group (16.7%) than in controls (83.3%) [p = 0.0033].[14] Similar results were also reported by Van Bogaert et al., who concluded that the incidence of hypotension was significantly reduced by wrapping (15.8%) as compared to controls (45.5%) [p=0.012], elevation did not prevent hypotension [p-0.38].[15]

Our study observed a significant difference in heart rate among the study groups. The leg wrapping group (BLW) heart rate was stable before and after delivery. In contrast, there was an increase in heart rate in both the leg elevation group (BLE) and control group (BC) before delivery. After delivery, in both groups (BLE and BC), there was a slight decrease in heart rate, but the heart rate in the leg elevation and control groups was significantly higher (p<0.05) than that in the leg wrapping group. This increase in heart rate might be a compensatory response to hypotension, which was significantly higher in both the BLE and BC groups, and due to the use of ephedrine, which was higher in the BLE and BC groups. Similar results were observed by Singh et al. in their study, where they concluded that a rise in heart rate was observed in the control group but not in the leg wrapping group before delivery.[12] In their study, there was no difference in heart rate between the control group and the BLE and BC groups after the baby's delivery. Nevertheless, our study showed a significant difference in the heart rate between the BLE and BC groups. This may be because ephedrine was used as a rescue vasopressor, whereas phenylephrine was used in their study.

In our study, there was a decrease in the mean systolic blood pressure in the leg elevation and control groups, especially at 4, 6, 8, and 10th minutes before and during delivery. After delivery, there was a slow and stable increase in systolic blood pressure. No significant decrease in systolic blood pressure below baseline was noted in the leg-wrapping group, and blood pressure was consistently maintained around baseline. This observation could be explained by the concept that around 500 to 600 ml of blood reaches the peripheral circulation during vasodilation caused by spinal anaesthesia. In the leg wrapping group, tight compression of the lower limbs by a crepe bandage prevented peripheral venous pooling. In addition, this compression of the lower limb offers resistance; thus, an increase in systemic vascular resistance also contributes to the prevention of hypotension.[16] Thus, there is an increase in venous return and systemic vascular resistance, explaining the reason for reasonably stable blood pressure during spinal anaesthesia. In the leg elevation group, leg elevation to 30°was insufficient to push the peripheral pooled blood to the central circulation, as vasodilation in postspinal anaesthesia was intense and required higher compressive pressure to increase venous return.

In our study, there was a decrease in mean arterial pressure from baseline in the leg elevation and control groups at the 4th, 6th, 8th, and 10th minute. However, the leg wrapping group did not show a significant decrease in the mean arterial blood pressure. In their study, Adsumelli et al. also reported a 50% higher incidence of significant mean arterial pressure reduction in the control group than in the sequential compression device group.[17] In the control group, a significantly higher incidence of hypotension occurred because of peripheral venous pooling of blood, which decreased venous return, and spinal anaesthesia caused vasodilation and

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decreased systemic vascular resistance. Similar results were also observed by Van Bogaert et al., who found a decrease in systolic blood pressure in all groups. Still, the mean systolic blood pressure remained significantly above the systolic blood pressure of control.[15]

In the leg-wrapped group, ephedrine usage was 6 mg in three patients. In the leg elevation group, ephedrine usage was 6 mg in 7 patients and 12 mg in 3 patients, and in the control group, 6 mg in 7 patients, 12 mg in 5 patients, 18 mg in 2 patients, and 2 mg in 1 patient. The total ephedrine dose in the leg-wrapped group was 18 mg. In the leg elevation group, it was 78 mg; in the control group, it was 162 mg. These findings in our study are following earlier reported studies.[18]

During this study, the patients were observed for any untoward side effects, such as nausea, vomiting, bradycardia, and dyspnoea. In the leg-wrapped BLW group, one patient experienced nausea. In the leg elevation BLE group, two patients had nausea, five patients had nausea, and two patients had vomiting. None of the patients vomited in the BLW or BLE groups. This was not statistically significant. Similarly, none of the three groups had bradycardia or dyspnoea. Bagle et al. also reported similar findings in their investigations.[19]

Limitations

We observed and analysed haemodynamic changes in parturients in this study, but the foetal outcomes were not studied.

CONCLUSION

We conclude that leg wrapping with an elastic crepe bandage just before the subarachnoid block significantly decreased the incidence of spinal hypotension and caused a marked reduction in vasopressor agents compared to leg elevation and control groups. Thus, the leg-wrapping technique eventually results in better uteroplacental circulation and foetal outcome maintenance.

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