

Comparative Study of Leg Wrapping Versus Leg Elevation for the Prevention of Hypotension in Spinal Anesthesia for Elective Cesarean Section

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Abstract

Background: The quality of the block required and the time required for the surgery influence the choice of local anesthetic drug. Lignocaine, the first amide local anesthetic agent was accepted for clinical use in the early 1950s.

Aim: This study aims to compare leg wrapping versus leg elevation for the prevention of hypotension in spinal anesthesia for elective cesarean section.

Materials and Methods: This is the prospective randomized controlled study comprised 60 full-term pregnant mothers with singleton uncomplicated pregnancy belonging to ASA Class 1 or 2, scheduled for elective cesarean section under spinal anesthesia, who were allocated randomly to either group blood pressure in the leg wrapped group (BLW) (leg wrapping) ($n = 30$) or group BLE (leg elevation) ($n = 30$) who were admitted in Government Maternity Hospital, Tirupati. Hypotension is defined as fall in systolic blood pressure to 90 mmHg or fall more than 20% from baseline blood pressure. Hypotension was treated immediately by increasing the rate of ringer lactate administration and by giving mephentermine 6 mg intravenously.

Results: Significant difference in systolic and diastolic blood pressure was present in the first 4–14 min. There is a significant fall in mean arterial pressure in the leg elevation group when compared to the leg wrapping group from 4 to 14 min. The BLW was stable, decrease in the blood pressure noted in 3 (10%) patients, compared to 10 (33.33%) patients in the leg elevated group (BLE). The difference in occurrence of hypotension in the study groups was statistically significant.

Conclusion: We conclude that the leg wrapping with elastic crepe bandage just before subarachnoid block significantly decreases the incidence of spinal hypotension as well as it causes a marked reduction in the use of vasopressor agents when compared to the leg elevation.

Key words: Hypotension, Leg elevation, Leg wrapping, Spinal anesthesia

INTRODUCTION

The quality of the block required and the time required for the surgery influence the choice of local anesthetic drug. Lignocaine, the first amide local anesthetic agent, was accepted for clinical use in the early 1950s. Following introduction of lignocaine into clinical practice, it was

widely used in spinal anesthesia. Because of transient effects, it is no longer used for spinal anesthesia. The first local anesthetic with a long duration of action, bupivacaine, is now the most commonly used local anesthetic drug.^[1]

Spinal anesthesia blockade up to the level of T4 is required to provide adequate anesthesia for cesarean section surgeries.^[2] Because of sympathetic blockade, hypotension is inevitable during spinal anesthesia. Prevention of spinal anesthesia-induced hypotension in cesarean section has been referred to as the Holy Grail in obstetric anesthesia.^[3,4] Despite enormous development in the knowledge of anesthetic drugs and techniques, hypotension in spinal anesthesia is still a major problem. Hypotension is defined

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as a drop of 20% in systolic blood pressure from baseline or a systolic blood pressure of <90 mmHg.^[5]

Hypotension causes dizziness, nausea, and vomiting, which makes the experience uncomfortable for the mother. In severe cases, neuraxial blockade-induced hypotension can result in loss of consciousness, pulmonary aspiration, apneic attacks, and even cardiac arrest. Sustained hypotension can impair uteroplacental perfusion, leading to fetal hypoxia and acidosis.^[6] Several studies were conducted to know the ideal treatment, which can be adopted to prevent hypotension during spinal anesthesia. Different techniques in use include IV fluid administration, pre-emptive and intraoperative vasopressor usage, and certain non-invasive physical methods. Intravenous fluids, either crystalloid or colloid, were used to increase intravascular volume and reduce hypotension. Although simple and easy, this technique cannot be used in cardiac patients and gestational hypertension.^[7] Colloid usage carries the risk of allergic responses and anaphylaxis. The relevance of preload in preventing spinal hypotension is presently debatable.^[8]

Physical methods such as left side table tilt (12.5–15°) and left uterine displacement using wedge relieve aortocaval compression, which, in turn, increase venous return. However, some studies have proven that these techniques do not significantly prevent hypotension.^[9,10] Venous pooling, which occurs due to peripheral vasodilation resulting from sympathetic blockade, is one of the most common reasons for spinal anesthesia-induced hypotension. Methods for compression of legs such as elastic crepe bandages, Esmarch bandages, compressive stockings, and leg elevation were studied for their effect on preventing spinal hypotension by reducing venous pooling of blood. These methods are non-invasive, simple, and easy but also have a better fetal outcome and improvement in venous return without increasing cardiac workload;^[11,12] nevertheless, localized ischemia and maternal discomfort rarely occur. The goal of this study was to see if leg wrapping and leg elevation, two promising and simple strategies for preventing spinal anesthesia-induced hypotension during elective cesarean sections, were effective.

MATERIALS AND METHODS

This is the prospective randomized controlled study comprised 60 full-term pregnant mothers with singleton uncomplicated pregnancy belonging to ASA Class 1 or 2, scheduled for elective cesarean section under spinal anesthesia, who were allocated randomly to either group BLW (leg wrapping) ($n = 30$) or group BLE (leg elevation) ($n = 30$) who were admitted in Government Maternity Hospital, Tirupati.

Inclusion Criteria

The following criteria were included in the study:

- Full-term, uncomplicated parturients scheduled for elective cesarean section
- ASA Grade 1–2
- Written and informed consent.

Exclusion Criteria

The following criteria were excluded from the study:

- Allergy to the drug – bupivacaine
- Patients of cardiovascular disease
- Fetal anomaly
- Pregnancy-induced hypertension
- Multiple gestation
- Contraindication for spinal anesthesia.

This study includes 60 pregnant women who were scheduled for an elective cesarean surgery. All pregnant mothers were thoroughly examined and investigated preoperatively and explained about the anesthetic technique. Written and informed consent was obtained from parturients and attendants.

Pregnant mother characteristics including weight, height, age, and gestational age were recorded. All the pregnant mothers were kept overnight fasting before surgery. For all parturients, intravenous line was secured using with an 18 Gauge cannula. All the pregnant mothers were given injection pantoprazole 40 mg intravenously and injection ondansetron 4 mg intravenously 30 min before the surgery.

Pregnant mothers were shifted to operation table and standard monitors such as pulse oximeter, non-invasive blood pressure cuff, and electrocardiogram leads were connected. Baseline blood pressure and heart rate were measured. Intravenous fluid preloading was given with 20 ml/kg of ringer lactate solution over 15–20 min just before the spinal anesthesia.

Group BLW pregnant mothers ($n = 30$) had the both lower limbs wrapped just before administration of spinal anesthesia. Leg wrapped with help of crepe bandage (15 cm width, 4 m stretched length) from ankle to mid-thigh in both legs in turns; during wrapping, legs were lifted at a 45° angle, after wrapping, legs were placed in neutral position and covered. The crepe bandages were wrapped tightly enough that the women will be 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 parturients had legs wrapped by the same person in around 3 min to eliminate bias introduced by method or altered force of wrapping.

Group LE ($n = 30$) pregnant mothers had their legs elevated immediately after spinal anesthesia such that they were at a 30° angle to the horizontal plane and covered.

Anesthesia Technique

Spinal anesthesia was performed under strict aseptic conditions in all pregnant mothers in the right lateral position using a 25 gauge Quincke's spinal needle in the L4-L5 interspace through midline approach. All parturients were given injection of 0.5% hyperbaric bupivacaine in the dose of 0.06 mg/cm of height.^[13] All pregnant mothers were given oxygen at 6 L/min through Hudson's face mask. The time of injection of spinal drug is noted as 0 min.

Maximum sensory block achieved and time to maximum sensory block were noted for all pregnant mothers. Fluid replacement was maintained with ringer lactate solution. Electrocardiography and oxygen saturation were monitored continuously and blood pressure and heart rate were measured every 2 min up to 20 min and every 5 min up to 60 min. Time from spinal to baby delivery and baby delivery to end of surgery were noted. Total duration of surgery and any intraoperative complications such as nausea, vomiting, hypotension, bradycardia, and dyspnea were recorded.

Hypotension is defined as fall in systolic blood pressure to 90 mmHg or fall more than 20% from baseline blood pressure. Hypotension was treated immediately by increasing the rate of ringer lactate administration and by giving mephentermine 6 mg intravenously. Total dose of mephentermine used was noted. Parameters were monitored and recorded in a specially prepared pro forma by other postgraduates who have not aware of the technique applied. Leg wrapping was removed after surgery. Pregnant mothers of the leg elevation group were resumed to supine position after surgery. Pregnant mothers of two groups were monitored for 10 min after surgery.

Statistical Analysis

Data were entered into Microsoft Excel and analysis was done using SPSS 24 version. Categorical data were represented in percentages and proportions. Continuous or quantitative data represented in means. Test of significance Chi-square was used for categorical data and unpaired *t*-test was used to compare means among two groups. *P* < 0.05 is taken as statistically significant.

RESULTS

Parturients with uncomplicated singleton pregnancy of term gestational age were included in this study. The mean age of group BLW was 25.2 years, group BLE was 25.9 years. There is no statistical difference in age comparison among the groups. The gestational age of two groups was comparable and there is no significant statistical difference between the groups (*P* = 0.59). All patients were comparable with regard to weight. The mean weight of the parturients of group BLW

was 57.73 kg, group BLE was 58.07 kg. There is no statistical difference observed among the groups [Table 1].

The mean heart rates were comparable in the two groups. Increase in mean heart rate observed in leg elevation (BLE) throughout the procedure. There were significant heart rate changes from 4 to 14 min after spinal anesthesia in BLE group compared to BLW group [Graph 1].

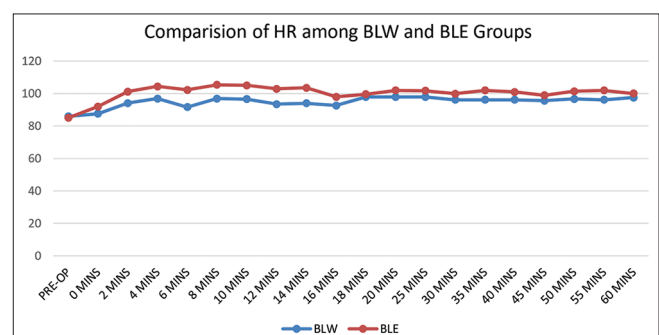
Significant difference in systolic and diastolic blood pressure was present in the first 4–14 min. Thereafter, there is no significant difference in both the groups. Mean arterial blood pressure was noted in both the groups and was comparable. There is significant fall in mean arterial pressure in the leg elevation group when compared to the leg wrapping group from 4 to 14 min. Mean arterial blood pressure values are shown in Table 2.

During this study, parturients of both the groups maintained saturation of 99–100%. All parturients were supplemented with oxygen 6 L/min through face mask. There was no significant difference among the study groups [Graph 2]. Mean length of surgery in group BLW was 47.6 min, group BLE was 49.1 min. Duration of surgery was comparable in both the groups. No statistical difference was observed in both the groups [Table 3].

The blood pressure in the leg wrapped group (BLW) was stable, decrease in the blood pressure noted in 3 (10%) patients, compared to 10 (33.33%) patients in the leg elevated group (BLE). The difference in occurrence of hypotension in the study groups was statistically significant. *P*-value was 0.02 (<0.05) when the leg wrapped group BLW was compared with the leg elevation group BLE. This was statistically significant [Table 4].

Table 1: Comparison of anthropometry

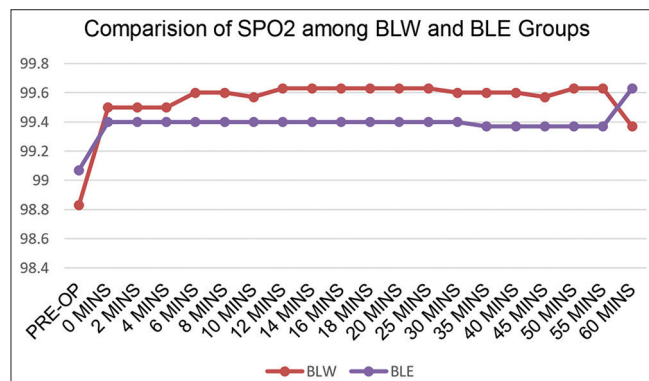
Group	Bilateral leg wrapping	Bilateral leg elevation	<i>P</i> -value
Weight in kg	57.73±4.38	58.07±4.11	0.76
Height in cm	149.97±5.40	150.83±4.58	0.56



Graph 1: Comparison of heart rate among the groups

Table 2: Comparison of mean arterial pressure

MAP in min	Group	Mean	SD	P-value
Pre-operative	BLW	84.40	7.70	0.738
	BLE	84.97	5.12	
0 min	BLW	88.50	9.48	0.429
	BLE	90.07	5.13	
2 min	BLW	85.20	5.55	0.291
	BLE	83.70	5.35	
4 min	BLW	85.37	7.62	0.0001
	BLE	78.40	4.56	
6 min	BLW	83.90	7.86	0.0001
	BLE	75.07	4.85	
8 min	BLW	84.20	6.77	0.001
	BLE	78.97	4.97	
10 min	BLW	80.97	5.24	0.016
	BLE	84.47	5.63	
12 min	BLW	84.47	6.95	0.001
	BLE	79.10	5.12	
14 min	BLW	85.63	5.62	0.037
	BLE	88.73	5.63	
16 min	BLW	84.80	7.68	0.091
	BLE	81.93	4.95	
18 min	BLW	82.53	6.47	0.091
	BLE	79.90	5.34	
20 min	BLW	79.93	5.71	0.216
	BLE	78.03	6.04	
25 min	BLW	77.53	4.97	0.904
	BLE	77.70	5.61	
30 min	BLW	79.40	5.59	0.200
	BLE	81.27	5.56	
35 min	BLW	68.27	7.33	0.187
	BLE	70.70	6.78	
40 min	BLW	82.73	6.39	0.078
	BLE	85.53	5.67	
45 min	BLW	81.90	5.68	0.170
	BLE	83.97	5.83	
50 min	BLW	83.00	5.55	0.608
	BLE	83.73	5.48	
55 min	BLW	84.77	5.25	0.229
	BLE	86.50	5.79	
60 min	BLW	70.83	9.68	0.087
	BLE	74.60	6.85	



Graph 2: Comparison of SPO₂ among the study groups

In the leg wrapped group BLW, one parturient had nausea, in the leg elevation group BLE, two parturients had nausea. None had vomiting in BLW and BLE group. This was not statistically significant. In the leg wrapped group,

Table 3: Comparison of time from delivery to end of surgery and duration of surgery

Parameters	Bilateral leg wrapping (Mean±SD)	Bilateral leg elevation (Mean±SD)	P-value
Delivery to end of surgery in minutes	40.5±2.78	41.9±3.78	0.10
Duration of surgery	47.6±2.65	49.1±3.71	0.07

Table 4: Comparison of incidence of hypotension

Hypotension	BLE	BLW	P-value
Absent	20 (67)	27 (90)	0.02
Present	10 (33)	3 (10)	
Total	30 (100)	30 (100)	

mephentermine usage was 6 mg in two parturients, 12 mg in one parturient. In the leg elevation group, mephentermine usage was 6 mg in 10 parturients, 12 mg in three parturients. Below table shows significant no. of parturients required rescue mephentermine in BLE group than BLW group [Table 5].

DISCUSSION

The main contribution for spinal hypotension is venous pooling in abdomen and legs, therefore, this study was done to investigate if leg wrapping prevents spinal hypotension in cesarean section and also decided to compare leg elevation technique with leg wrapping for the same. The aim of this study was to evaluate and compare the hemodynamic changes, the incidence of hypotension, and need for usage of vasopressor in spinal anesthesia for elective cesarean section between leg wrapping and leg elevation.

Sixty parturients were randomly assigned to the group BLW ($n = 30$) and BLE ($n = 30$). In this study, parturients were comparable in demographic data. No significant difference in both groups comparing age, weight, height, and gestational age. In this study, 1.8 ml of 0.5% bupivacaine was used for all parturients.

Kunal *et al.*^[14] had used 2.5 ml of 0.5% hyperbaric bupivacaine for all patients in their study. Dosage of hyperbaric bupivacaine (0.5%) is according to height, as the mean height in their study was 164 cm. However, this study was conducted in South India, where the average height was 152 cm for females. In this study, the mean height was 149.97 cm in the BLW group and 150.83 cm in the BLE group.

Maximum spinal block level, time to reach maximum block, time from spinal to delivery of baby, time from delivery to

Table 5: Comparison of side effects and mephentermine usage among the study groups

Nausea	BLE	BLW	P-value
Absent	28 (93)	29 (97)	0.554
Present	2 (7)	1 (3)	
Total	30 (100)	30 (100)	
Mephentermine			0.013
Nil	17 (56.7)	27 (90)	
6 mg	10 (33.3)	2 (6.6)	
6+6 mg	3 (10)	1 (3.4)	
Total	30 (100)	30 (100)	

end of the surgery, and total duration of surgery were also noted and compared. In terms of clinical data, there was insignificant difference between the groups. There was no influence by leg elevation on maximum block level or time to achieve maximum block level. In a study conducted by Rout *et al.*^[15] also, they had concluded that leg elevation to 30° had not influenced block height.

Here, in this study, it was observed that there is a decrease in the occurrence of hypotension, reduction in necessity of rescue vasopressor mephentermine in the leg wrapping group BLW when compared to the leg elevation group BLE. The incidence of spinal hypotension in the leg wrapped group BLW was 3 patients (10%) whereas in the elevated leg group BLE was ten patients (33.33%) ($P = 0.0282$). This observation implies that leg wrapping significantly prevents spinal hypotension compared to the leg elevation. Leg elevation had no discernible effect on the occurrence of hypotension. Leg wrapping prophylactic efficacy in prevention of spinal hypotension has already been researched.

Rout *et al.*^[15] also compared leg wrapping and leg elevation to prevent spinal hypotension in elective cesarean section. In comparison to the control group (53%), leg elevation and wrapping with an elastic Esmarch bandage resulted in a considerable reduction in the frequency of post-spinal hypotension (18%). Only leg elevation failed to significantly reduce the incidence of hypotension according to their findings (39 %). Das and Swain^[15] also concluded that the occurrence of hypotension in the leg wrapped group is 13.33% compare to 63.33% in the control group, which was statistically significant ($P = 0.002$). Bhagwanjee *et al.*^[16] compared 24 parturients undergoing elective cesarean section who were randomly assigned to have their legs wrapped with elastic Esmarch bandages immediately following spinal anesthesia or to serve as controls, and they discovered that the incidence of hypotension was significantly lower in the leg wrapped group (16.7%) than in the control group (83.3%) ($P = 0.0033$). Similar results were found in a study by Van Bogaert *et al.*^[17] who concluded that incidence of hypotension was significantly decreased by wrapping (15.8%) as compared with controls

(45.5%) ($P = 0.012$), elevation did not avoid hypotension ($P=0.38$). Khedr *et al.*^[18] have also concluded that wrapping and elevation of leg were more effective in preventing post-spinal hypotension in parturients in elective cesarean section. Kunal *et al.*^[14] have also concluded that hypotension can be reduced by wrapping the legs with elastic crepe bandage with a subsequent reduction in the use of potent vasopressor (10%) compared to the control group (33.33%) where wrapping was not done.

A considerable difference in heart rate was observed in this study among the study groups. There were significant heart rate changes from 4 to 14 min after spinal anesthesia. In the leg wrapping group BLW, heart rate was stable before and after delivery, but there was a rise in heart rate in the leg elevation group BLE before delivery of a baby. After delivery, there was a slow fall in heart rate in group BLE, but still heart rate was significantly higher while compared to the leg wrapping group. This rise in heart rate might be a compensatory response to hypotension. The occurrence was considerably higher in group BLE and due to the usage of mephentermine, which was high in group BLE. Similar results were observed by Das and Swain^[19] in his study concluded that there were significant heart changes from 4 to 15 min following spinal anesthesia in the control group compared to the leg wrapped group. Kunal *et al.*^[14] concluded that a rise in heart rate was observed in the control group but not in the leg wrapping group before delivery. In their study after baby delivery, there was no disparity in heart rate in group BLW and control group, but in this study, there was a considerable difference in heart rate in group BLW and group BLE. This might be as we used mephentermine as a rescue vasopressor, whereas in their study, they used phenylephrine as a rescue vasopressor.

In this study, there was a considerable fall in mean arterial pressure in group BLE at 4–14 min, but significant decrease in the mean arterial blood pressure was not noted in group BLW. Das and Swain^[19] found a significant change in MAP from 4 to 15 min after spinal anesthesia in the control group compared to the leg wrapped group. Kunal *et al.*^[14] found that at the 4, 6, and 8 min, there was a highly substantially lower MAP in the control group than in the leg wrapped group. Bagle *et al.*^[20] found a significant drop in MAP at 3, 6, 9, and 12 min in the control group but not in the leg wrapped group.

The requirement of rescue mephentermine was less in the leg wrapped group BLW, a dose of 6 mg intravenously for two parturients and 12 mg for one parturient, whereas in the group BLE, requirement of rescue mephentermine was 6 mg iv in 10 parturients and 12 mg iv in three parturients. Thus, the requirement of mephentermine was significantly low in the group BLW compared to the leg elevation group. The study conducted by Das and Swain^[19]

showed that in the control group, a significant number of parturients required rescue vasopressor compared to the leg wrapped group. The study conducted by Bagle *et al.*^[20] also showed that vasopressor requirement per parturient was considerably high in the control group compared to the leg wrapped group. Similar result was seen in the study conducted by Kunal Singh *et al.*^[14].

During this study, pregnant mothers were observed for any untoward side effects such as nausea, vomiting, bradycardia, and dyspnea. In group BLW, one parturient had nausea. In group BLE, two parturients had nausea. None had vomited in BLW and BLE groups. This was not statistically significant. Similarly, none had bradycardia or dyspnea in both groups. In the study conducted by DAS and Swain,^[15] there is a significant difference in incidence of nausea, vomiting, and shivering in the control group compared to the leg wrapped group. In the study conducted by Hasanin *et al.*,^[21] there was insignificant difference in leg elevation and control groups regarding intraoperative and post-operative nausea and vomiting.

Limitations

In this study, the hemodynamic changes were observed and analyzed in parturients but the fetal outcome was not studied.

CONCLUSION

We conclude that the leg wrapping with elastic crepe bandage just before subarachnoid block significantly decreases the incidence of spinal hypotension as well as it causes a marked reduction in the use of vasopressor agents when compared to the leg elevation. Thus, the leg wrapping technique eventually results in better hemodynamic stability. As leg wrapping with the elastic crepe bandage is cheap, easy, readily available, and non-invasive, the technique can be recommended along with other routinely used techniques like left uterine displacement with a wedge for preventing the spinal hypotension and for better maternal and fetal care.

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