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ORIGINAL RESEARCH

A COMPARATIVE STUDY OF LEG WRAPPING VERSUS LEG ELEVATION FOR PREVENTION OF HYPOTENSION IN SPINAL ANAESTHESIA FOR ELECTIVE CAESREAN SECTION

[1]Dr. Mude Nage Ramesh Kumar, [2]Dr. T. Kumar, [3]Dr. Sreenivasulu Yadav Surineni, [4]Dr. Sunil Nanjarapalle

[1-4]Assistant Professor, Department of Anesthesiology, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India

Correspondence:
Dr. Sunil Nanjarapalle
Assistant Professor, Department of Anesthesiology, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India
Email: 25drsunil@gmail.com

Abstract

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

Aim: To compare leg wrapping versus leg elevation for prevention of hypotension in spinal anaesthesia for elective caesrean section.

Material and methods: This is the prospective randomized controlled study comprised of 60 full term pregnant mothers with singleton uncomplicated pregnancy belonging to ASA class 1 or 2, scheduled for elective caesarean 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, Tirupathi. 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 mephenteramine 6mg intravenously.

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

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causes a marked reduction in the use of vasopressor agents when compared to the leg elevation.

Keywords: Hypotension, Spinal Anaesthesia, Leg Wrapping, Leg Elevation

Introduction

The quality of the block required and the time required for the surgery influence the choice of local anaesthetic drug. Lignocaine, the first amide local anaesthetic agent, was accepted for clinical use in the early 1950s. Following introduction of lignocaine into clinical practise, it was widely used in spinal anaesthesia. Because of transient effects, it is no longer used for spinal anaesthesia. The first local anaesthetic with a long duration of action, Bupivacaine, is now the most commonly used local anaesthetic drug[1].

Spinal Anesthesia blockade up to 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 HolyGrail in obstetric anaesthesia.[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 as a drop of 20% in systolic blood pressure from baseline or a systolic blood pressure of less than 90mmHg.[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. Though 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 like left side table tilt (12.5˚to15˚) and left uterine displacement using wedge relieve aortocaval compression, which in turn increase venous return. But 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 like 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 caesarean sections, were effective.

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Materials and methods

This is the prospective randomized controlled study comprised of 60 full term pregnant mothers with singleton uncomplicated pregnancy belonging to ASA class 1 or 2, scheduled for elective caesarean 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, Tirupathi.

Inclusion Criteria

- Full-term, uncomplicated parturients scheduled for elective caesarean section.
- ASA grade 1 or 2.
- Written and informed consent.

Exclusion Criteria

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

This study includes 60 pregnant women who were scheduled for an elective caesarean surgery. All Pregnant mothers were thoroughly examined and investigated preoperatively and explained about the anaesthetic technique. Written &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 18Gauge cannula. All the Pregnant mothers were given injection Pantoprazole 40mg intravenously and injection ondonsetran 4mg intravenously 30 minutes before the surgery.

Pregnant mothers were shifted to operation table and standard monitors like pulse oximeter, non-invasive blood pressure cuff, 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 to 20 minutes just prior to 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 degree 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 anaesthesia such that they were at a 30 degree angle to the horizontal plane and covered.

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Anaesthesia Technique

Spinal anaesthesia 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 0.06mg/cm of height[66]. All

Pregnant mothers were given oxygen at 6L/min through Hudson's face mask. The time of injection of spinal drug is noted as 0 minute.

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 minutes up to 20 minutes and every 5 min up to 60minutes. 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 dyspnoea 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 mephenteramine 6mg intravenously. Total dose of mephenteramine used was noted. Parameters were monitored and recorded in a specially prepared proforma by other post graduate who have not aware of the technique applied. Leg wrapping was removed after surgery. Pregnant mothers of leg elevation group were resumed to supine position after surgery. Pregnant mothers of two groups were monitored for 10 minutes after surgery.

Statistical Analysis

Data was entered in Microsoft excel and Analysis was done using SPSS 24 version. Categorical data was represented in percentages and proportions. Contionous 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. A p value of less than 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 25.2years, group BLE was 25.9 years. There is no statistical difference in age comparison among the groups. The gestational age of 2 groups were 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 57.73kg, group BLE was 58.07kg. There is no statistical difference observed among the groups (table 1).

Table 1: Comparison of Anthropometry

Group	Bilateral Leg Wrapping	Bilateral Leg Elevation	p value
Weight in kg	57.73 $\pm$ 4.38	58.07$\pm$ 4.11	0.76
Height in cm	149.97 $\pm$ 5.40	150.83 $\pm$ 4.58	0.56

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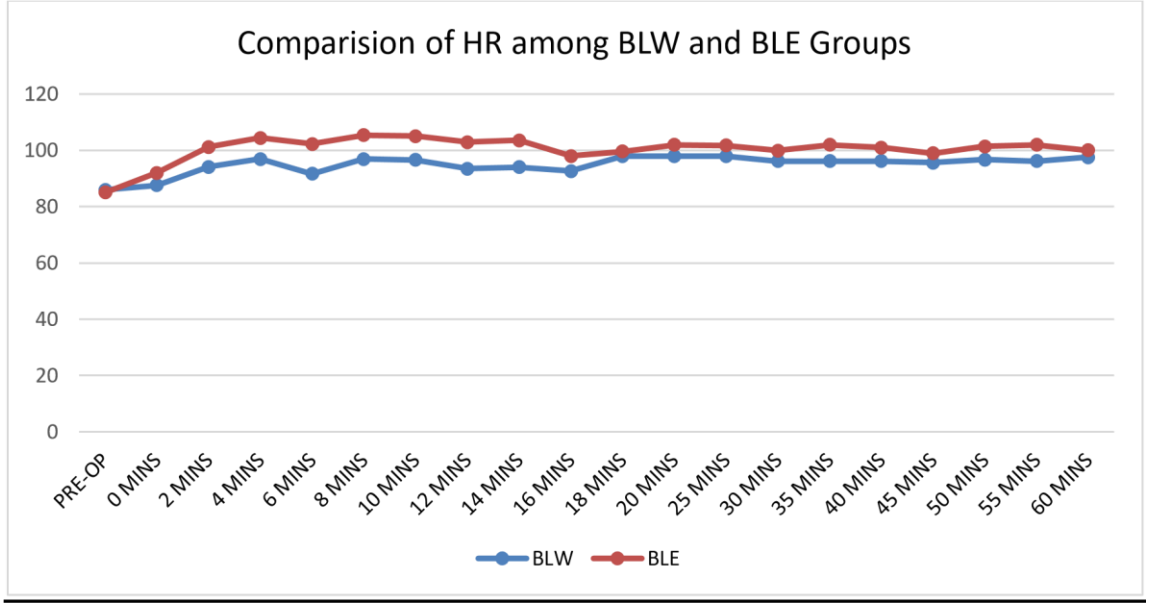
The mean heart rates were comparable in the two groups. Increase in mean heart rate observed in leg elevation (BLE) throughout the procedure. There were significant heart rate changes from 4-14 minutes after spinal anesthesia in BLE group compared to BLW group (graph 1).

Graph 1: Comparison of heart rate among the groups



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

Table 2: Comparison of Mean Arterial Pressure

MAP in Min	Group	Mean	SD	p value
PRE-OP	BLW	84.40	7.70	0.738
	BLE	84.97	5.12	
0 MINS	BLW	88.50	9.48	0.429
	BLE	90.07	5.13	
2 MINS	BLW	85.20	5.55	0.291
	BLE	83.70	5.35	
4 MINS	BLW	85.37	7.62	**0.0001**
	BLE	78.40	4.56	
6 MINS	BLW	83.90	7.86	**0.0001**
	BLE	75.07	4.85	
8 MINS	BLW	84.20	6.77	**0.001**
	BLE	78.97	4.97	
10 MINS	BLW	80.97	5.24	**0.016**
	BLE	84.47	5.63	
12 MINS	BLW	84.47	6.95	**0.001**

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	BLE	79.10	5.12	
14 MINS	BLW	85.63	5.62	**0.037**
	BLE	88.73	5.63	
16 MINS	BLW	84.80	7.68	0.091
	BLE	81.93	4.95	
18 MINS	BLW	82.53	6.47	0.091
	BLE	79.90	5.34	
20 MINS	BLW	79.93	5.71	0.216
	BLE	78.03	6.04	
25 MINS	BLW	77.53	4.97	0.904
	BLE	77.70	5.61	
30 MINS	BLW	79.40	5.59	0.200
	BLE	81.27	5.56	
35 MINS	BLW	68.27	7.33	0.187
	BLE	70.70	6.78	
40 MINS	BLW	82.73	6.39	0.078
	BLE	85.53	5.67	
45 MINS	BLW	81.90	5.68	0.170
	BLE	83.97	5.83	
50 MINS	BLW	83.00	5.55	0.608
	BLE	83.73	5.48	
55 MINS	BLW	84.77	5.25	0.229
	BLE	86.50	5.79	
60 MINS	BLW	70.83	9.68	0.087
	BLE	74.60	6.85	

During this study parturients of both the groups maintained saturation of 99% to 100%. All parturients were supplemented with oxygen 6litres per minute through face mask. There was no significant difference among the study groups (graph 2).

Graph 2: Comparison of SPO2 among the study groups

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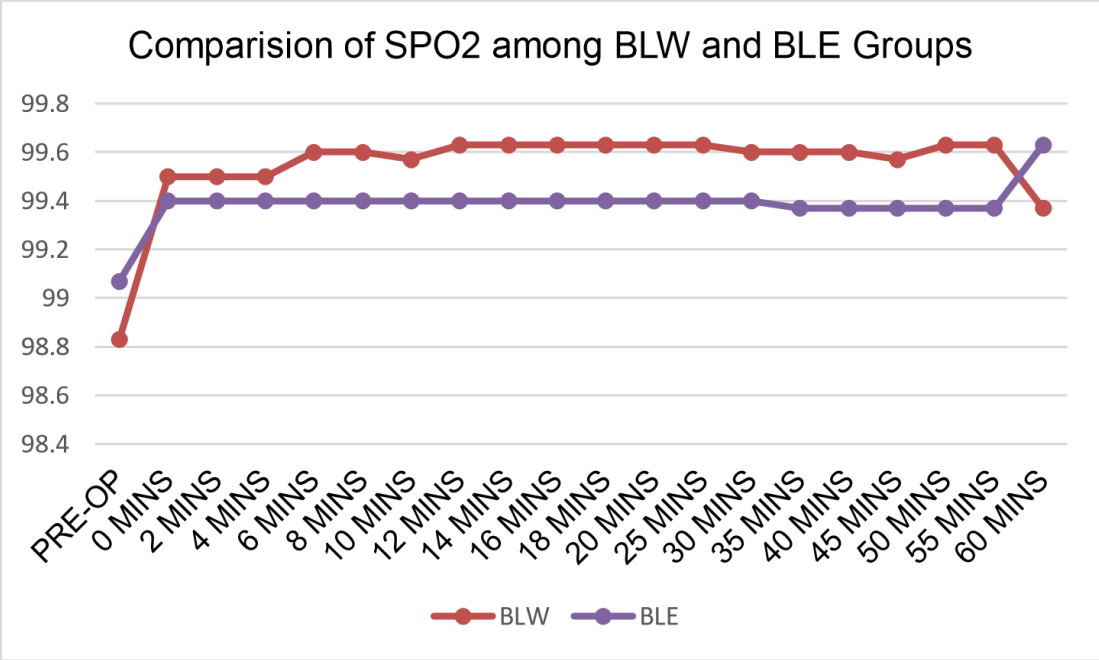

Mean length of surgery in group BLW was 47.6minutes, group BLE was 49.1minutes. Duration of surgery was comparable in both the groups. No statistical difference was observed in both the groups (table 3).

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

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

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)	

In leg wrapped group BLW one parturient had nausea, in leg elevation group BLE two parturients had nausea. None had vomiting in BLW and BLE group. This was not statistically significant. In leg wrapped group mephenteramine usage was 6mg in 2 parturients, 12mg in 1 parturient. In leg elevation group mephenteramine usage was 6mg in 10parturients, 12mg in 3parturients. Below table shows significant no. of parturients required rescue mephenteramine in BLE group than BLW group (table 5).

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Table 5: Comparison of side effects and Mephenteramine 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)	
Mephenteramine			
Nil	17 (56.7)	27 (90)	0.013
6mg	10 (33.3)	2 (6.6)	
6+6mg	3 (10)	1 (3.4)	
Total	30(100)	30(100)	

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, need for usage of vasopressor in spinal anesthesia for elective caesarean section between leg wrapping, leg elevation.

60 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 1.8ml of 0.5% bupivacaine was used for all parturients.

Kunal et al.[13] had used 2.5ml 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 164cm. But this study was conducted in south India, where the average height was 152cm for females. In this study, the mean height was 149.97cm in the BLW group and 150.83cm in the BLE group.

Maximum spinal block level, time to reach maximum block, time from spinal to delivery of baby, time from delivery to 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 upon maximum block-level or time to achieve maximum block level. In a study conducted by **CC Rout et al.**[14] 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 mephenteramine in the leg wrapping group BLW when compared to leg elevation group BLE. The incidence of spinal hypotension in leg wrapped group BLW was 3patients (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.

C.C.Rout et al.[14] also compared leg wrapping and leg elevation to prevent spinal hypotension in elective cesarean section. In comparison to the control group (53%), leg

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elevation and wrapping with an elastic esmarch bandage resulted in a considerable reduction in the frequence of postspinal hypotensions (18%). Only Leg elevation failed to significantly reduce the incidence of hypotension acccording to their findings (39 %). **Das P et al.[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 S et al.[16]** compared 24 parturients undergoing elective caesarean section who were randomly assigned to have their legs wrapped with elastic esmarch bandages immediately following spinal anaesthesia or to serve as controls, and they discovered that the incidence of hypotension was significantly lower in the leg wrapped group (16.7 percent) than in the control group (83.3 percent) [P = 0.0033]. Similar results were found in a Study by **L.J. 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]. **Nahid F. khedr et al[18]** has also concluded that wrapping and elevation of leg were more effective in preventing postspinal hypotension in parturients in elective cesarean section. **Kunal Singh et al.[13]** has 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 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 minutes 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 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 mephenteramine, which was high in group BLE. Similar results were observed by **Das P et al.[15]** in his study concluded that there were significant heart changes from 4 to 15 minutes following spinal anesthesia in control group compared to leg wrapped group. **Kunal Singh et al.[13]** 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 mephenteramine 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 to 14 minutes, but significant decrease in the mean arterial blood pressure was not noted in group BLW. **Das P et al.[15]** found a significant change in MAP from 4 to 15 minutes after spinal anaesthesia in the control group compared to the leg wrapped group. **Kunal Singh et al.[13]** found that at the 4, 6, 8 minutes, there was a highly substantially lower MAP in the control group than in the leg wrapped group. **Bagle AA et al[19]** found a significant drop in MAP at 3,6,9,12 minutes in the control group but not in the leg wrapped group.

The requirement of rescue mephenteramine was less in leg wrapped group BLW, a dose of 6 mg intravenously for two parturients and 12mg for one parturient, whereas in the group BLE, requirement of rescue mephenteramine was 6 mg iv in 10 parturients 12mg iv in 3 parturients. Thus the requirement of mephenteramine was significantly low in the group

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BLW compared to the leg elevation group. The study conducted by **Das P et al.**[15] showed that in the control group, a significant number of parturients required rescue vasopressor compared to leg wrapped group. The study conducted by **Bagle AA et al.**[19] also showed that vasopressor requirement per parturient was considerably high in control group compared to leg wrapped group. In the Study conducted by **Kunal Singh et al.**[13] also showed that vasopressor requirement for parturients was considerably high in control group compared to leg wrapped group.

During this study, pregnant mothers were observed for any untoward side effects like nausea, vomiting, bradycardia, dyspnoea. 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 dyspnoea in both groups. In the study conducted by **DAS P et al.**[15] there is significant difference in incidence of nausea, vomiting, and shivering in control group compared to leg wrapped group. In the study conducted by **Ahmed Hasanin et al.**[20] There was insignificant difference in leg elevation and control groups regarding intra operative 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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