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# TO INVESTIGATE THE EFFECTIVENESS OF PRELOADING AND WRAPPING OF LEGS IN PREVENTING HYPOTENSION AFTER SPINAL ANAESTHESIA DURING ELECTIVE CAESAREAN SECTION: A COMPARATIVE STUDY

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## Abstract

**Background:** The use of spinal blockade has been shown to have a high level of efficacy in providing anaesthesia to patients who are having caesarean section procedures. Nevertheless, the occurrence of hypotension after spinal anaesthesia is a prevalent adverse event often seen in patients having caesarean section. The aim is to investigate the effectiveness of preloading and wrapping of legs in preventing hypotension after spinal anaesthesia during elective caesarean section. **Materials and Methods:** All patients who are scheduled to have an elective lower segment caesarean section were get spinal anaesthesia. The patients were categorized into two distinct categories. patients in Group 1 were administered a preloading treatment consisting of 15ml/kg of Ringer Lactate solution. On the other hand, patients in Group 2 had a procedure including the application of elasticated crepe bandages from the ankle to the mid-thigh. **Result:** The average arterial blood pressure in group 2 exhibited a statistically significant decrease ($p<0.05$) at time points 4, 6, 8, 15, and 20 minutes when compared to group 1. Approximately 11.43% of patients in Group 1 exhibited the occurrence of hypotension, while 34.29% of patients in Group 2 experienced the development of hypotension. There was a statistically significant difference in the occurrence of hypotension between Group 2 and Group 1, with Group 2 exhibiting a greater incidence ($p=0.03$). **Conclusion:** We concluded that the administration of intravenous crystalloids at a rate of 15ml/kg as a volume preloading technique demonstrates a significant reduction in the occurrence of spinal hypotension in comparison to the use of stretchy crepe bandages wrapped around the legs from the ankle to the mid thigh.

## INTRODUCTION

Administering anaesthesia for a caesarean section, whether it is a elective or emergency surgery, has always presented a complex and demanding task. There is a growing emphasis on the enhanced utilisation of regional anaesthesia in obstetrics, as opposed to general anaesthesia. This shift is primarily motivated by several factors, including the risk of aspiration of gastric contents associated with general anaesthesia, the potential for failed endotracheal intubation, the depressant effects of general anaesthetic drugs on the foetus, the observed improvement in uteroplacental circulation with regional anaesthesia, and the preservation of maternal awareness achieved through regional anaesthesia.[1] The caesarean section has emerged as the prevailing surgical intervention in contemporary medical practise. The use of central neuraxial blockade has emerged as the favoured anaesthesia approach for caesarean sections, resulting in a significant decline in the utilisation of general anesthesia.[2] The potential risks associated with general anaesthesia include several complications such as unsuccessful endotracheal intubation, inadequate ventilation, aspiration pneumonitis, postoperative nausea and vomiting, as well as newborn depression.[3,4] Despite its effectiveness in providing anaesthesia, spinal anaesthesia is often accompanied by side consequences such as hypotension. The degree of block accomplished determines the extent of hypotension induced.[5] The extent of sympathetic block is contingent upon the extent to which the local anaesthetic medicine is distributed in a cephalad manner inside the subarachnoid space. The heightened sensitivity of parturients to local anaesthetics, along with the impact of aortocaval compression, leads to an augmented degree of


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obstruction and a higher frequency and severity of hypotension.[6] The occurrence of greater venous pooling in the lower extremities is attributed to the heightened level of peripheral vasodilation seen in parturients. The process of vasodilation leads to the accumulation of around 500-600 ml of blood in the peripheral compartment, resulting in a decrease in venous return and subsequently reducing cardiac output. Pregnant individuals have a heightened baroreceptor response in comparison to their non-pregnant counterparts. The heart rate exhibits an increase in response to hypotension due to the activation of baroreceptors. Bradycardia may also manifest as a result of spinal anaesthesia administered at a high dosage.[7] The treatment of spinal hypotension under obstetric anaesthesia is a persistent challenge due to the need to consider the well-being of both the mother and the unborn simultaneously. The prognostic outcomes for both the mother and the unborn after spinal anaesthesia are influenced by two important factors: the intensity and duration of hypotension. A multitude of strategies have been explored in order to mitigate the occurrence of spinal hypotension. The practise of preloading fluids has historically been recommended as a preventive measure against hypotension after spinal anaesthesia. The application of lower limb compression systems, such as elastic compressive stockings, pneumatic stockings, Esmarch bandages, or leg wrappings with crepe bandage, can contribute to the regulation of blood pressure through various mechanisms. These include enhancing venous return to the heart, reducing the accumulation of blood in the lower extremities, and augmenting resistance within the peripheral circulatory system. This phenomenon results in an elevation in venous return and has been shown to reduce the occurrence of hypotension while maintaining enough blood flow to the uterus and placenta. Consequently, the enhancement of the mother's hemodynamic stability leads to an increased likelihood of survival for the foetus.[8,9]

## MATERIALS AND METHODS

This research was undertaken within the department of Anesthesiology. All patients who are scheduled to have an elective lower segment caesarean section were get spinal anaesthesia. The patients were categorized into two distinct categories. The composition of each group comprises 35 individuals, as determined by the specified inclusion and exclusion criteria. In this investigation, informed permission was appropriately acquired from all participants.

In this study, patients in Group 1 were administered a preloading treatment consisting of 15ml/kg of Ringer Lactate solution. On the other hand, patients in Group 2 had a procedure including the application of elasticated crepe bandages from the ankle to the mid-thigh. The existence of sufficient capillary pulsation in the toes was utilised as an indicator to verify that arterial pressure remained within acceptable limits. The use of elastic crepe bandages for the purpose of leg wrapping is a common practise. A comprehensive pre-anesthetic assessment was conducted, which included a detailed patient history, thorough physical examination, inspection of the spine, and evaluation of the airway. This assessment was performed the day before to the surgical procedure. All standard laboratory tests, including haemoglobin, differential count, total leukocyte count, bleeding time, clotting time, serum urea, serum creatinine, serum sodium, serum potassium, and fasting blood sugar, yielded results that were within the normal range for all patients. Prior to the surgical procedure, all patients were instructed to abstain from oral intake for a duration of 8 hours. In all patients, an intravenous line was established using an 18-gauge cannula.

The pulse-oximeter, ECG and non-invasive blood pressure monitors were affixed. Baseline blood pressure and heart rate were assessed in all patients. The baseline values were determined by calculating the average of three consecutive measurements prior to the administration of spinal anaesthesia. The use of crepe bandage (15 cm width, 4m stretched length) was utilised to wrap the legs, commencing at the ankle and extending to the mid-thigh region in both lower extremities. The crepe bandages were applied with sufficient tension, providing a sensation of tightness that was perceived by the ladies. However, it was reported as being pleasant and devoid of any discomfort. Precautions were made to prevent compression of the legs beyond the systolic arterial pressure by assessing the presence of capillary pulsation in the toes. To guarantee blinding, the crepe bandage was concealed after being wrapped. During the intraoperative period, the patient's pulse rate, electrocardiography, non-invasive blood pressure, and oxygen saturation were continually monitored. The administration of oxygen was facilitated with the use of a face mask. Fluid replenishment was sustained using Ringer's lactate solution. The degree of hypotension was specifically observed. Hypotension is operationally defined as a decrease in systolic blood pressure to equal to or less than 90 mmHg, or a drop of 20% from the individual's baseline blood pressure.

**Statistical Analysis**

The data that was produced underwent statistical analysis. The parametric data were reported as the mean plus or minus the standard deviation for the unpaired Student's t-test, whereas the numbers and percentages were used for the chi-square test. The comparison of quantitative data between the two groups was conducted using an Unpaired Student's t-test. The Chi-square test was used to compare qualitative data between the two groups. The level of statistical significance was established at a threshold of $P<0.05$. The statistical analyses were conducted on a computer running the Windows operating system, with the SPSS 20.0 software programme.


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## RESULTS

[Table 1] presents the fundamental distribution of patient parameters within the two groups. The mean age of the patients in Group 1 and Group 2 was 26.12 ± 2.88 years and 25.39 ± 1.96 years, respectively. There was no statistically significant difference in the distribution of patients between Group 1 and Group 2 in terms of age. The average weight of the participants in the first group was 73.11± 7.59 kilogrammes, whereas the average weight of the participants in the second group was 74.31± 7.17 kilogrammes. The height of the individuals in the two groups was recorded as 155.43± 4.39 and 155.21± 4.57 centimetres, respectively. The distribution of height and weight exhibited comparable patterns in both drug groups, and the observed differences were not statistically significant ($p>0.05$).

[Table 2] presents a comparison of the heart rate measurements taken from patients both before the operation and at various time intervals (Baseline, 2, 4, 6, 8, 10, 15, 20, 25, 30, 35, 40, 45, 60, 75, and 90 minutes) in groups 1 and 2. The heart rate in group 1 exhibited a statistically significant decrease ($p<0.05$) at time points 4, 20, 25, 30, 35, 40, 45, 60, 75, and 90 minutes as compared to group 2.

[Table 3] presents a comparative analysis of the mean arterial blood pressure among the patients before to surgery and at various time points: Baseline, 2, 4, 6, 8, 10, 15, 20, 25, 30, 35, 40, 45, 60, 75, and 90 minutes. The comparison is made between groups 1 and 2. The average arterial blood pressure in group 2 exhibited a statistically significant decrease ($p<0.05$) at time points 4, 6, 8, 15, and 20 minutes when compared to group 1.

[Table 4] shows the occurrence of hypotension within the two cohorts. Approximately 11.43% of patients in Group 1 exhibited the occurrence of hypotension, while 34.29% of patients in Group 2 experienced the development of hypotension. There was a statistically significant difference in the occurrence of hypotension between Group 2 and Group 1, with Group 2 exhibiting a greater incidence ($p=0.03$).

[Table 5] There is a notable disparity in the occurrence of nausea, vomiting, and shivering between the two groups. The occurrence of nausea and vomiting is seen in 11.43% of patients in Group 1, whereas it is present in 20% of patients in Group 2, indicating a statistically significant difference between the two groups. The occurrence of shivering in Group 1 patients is 8.57%, but in Group 2, it is 20%, indicating a statistically significant difference.

**Table 1: basic profile of the participants**

| Gender | Group 1=35 | | Group 2=35 | | P value |
|---|---|---|---|---|---|
| | Number/ Mean | Percentage | Number/ Mean | Percentage | |
| Female | 35 | 100 | 35 | 100 | |
| Age(in years) | 26.12± 2.88 | | 25.39 ± 1.96 | | 0.51 |
| Height (in cm) | 155.43± 4.39 | | 155.21± 4.57 | | 0.17 |
| weight (in kg) | 73.11± 7.59 | | 74.31± 7.17 | | 0.22 |

**Table 2: Heart rate (bpm) of patients**

| Heart Rate (bpm) | Group 1=35 | | Group 2=35 | | P value |
|---|---|---|---|---|---|
| | Mean | Sd | Mean | Sd | |
| Pre-Operative | 85.03 | 5.36 | 86.33 | 5.19 | 0.36 |
| Baseline | 88.06 | 5.16 | 93.33 | 5.13 | 0.21 |
| 2 | 95.01 | 4.89 | 102.04 | 5.10 | 0.41 |
| 4 | 97.06 | 5.11 | 106.34 | 5.31 | 0.03 |
| 6 | 98.17 | 4.96 | 102.25 | 5.04 | 0.15 |
| 8 | 96.11 | 5.27 | 101.08 | 5.22 | 0.37 |
| 10 | 97.24 | 5.55 | 104.89 | 5.63 | 0.18 |
| 15 | 97.03 | 4.33 | 102.58 | 5.66 | 0.37 |
| 20 | 93.99 | 5.55 | 103.66 | 4.93 | 0.004 |
| 25 | 93.01 | 5.11 | 107.05 | 4.88 | 0.001 |
| 30 | 91.11 | 5.09 | 102.27 | 5.17 | 0.004 |
| 35 | 89.03 | 4.79 | 110.14 | 4.33 | 0.001 |
| 40 | 91.34 | 4.67 | 106.18 | 4.37 | 0.002 |
| 45 | 94.22 | 4.13 | 103.17 | 4.23 | 0.003 |
| 60 | 89.34 | 4.03 | 106.11 | 4.08 | 0.001 |
| 75 | 86.14 | 4.33 | 107.05 | 4.04 | 0.001 |
| 90 | 86.01 | 3.36 | 108.14 | 3.69 | 0.001 |

**Table 3: MAP (mmhg) of patients**

| MAP (mmHg) | Group 1=35 | | Group 2=35 | | P value |
|---|---|---|---|---|---|
| | Mean | Sd | Mean | Sd | |
| Pre-Operative | 93.99 | 3.69 | 95.89 | 3.78 | 0.33 |
| Baseline | 89.14 | 3.89 | 91.25 | 3.74 | 0.17 |
| 2 | 86.05 | 3.74 | 84.25 | 3.71 | 0.23 |
| 4 | 86.02 | 3.25 | 79.33 | 3.62 | 0.002 |
| 6 | 84.22 | 3.17 | 76.85 | 3.45 | 0.001 |
| 8 | 85.25 | 3.54 | 79.16 | 3.61 | 0.003 |
| 10 | 83.31 | 3.16 | 81.06 | 3.02 | 0.41 |


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| | | | | | |
|---|---|---|---|---|---|
| 15 | 85.12 | 3.71 | 80.06 | 3.08 | 0.004 |
| 20 | 87.99 | 2.52 | 81.98 | 2.21 | 0.001 |
| 25 | 87.02 | 3.74 | 85.14 | 3.74 | 0.24 |
| 30 | 83.05 | 3.08 | 80.05 | 3.98 | 0.33 |
| 35 | 80.41 | 3.33 | 79.02 | 3.33 | 0.15 |
| 40 | 78.14 | 3.14 | 78.85 | 3.37 | 0.41 |
| 45 | 80.05 | 3.02 | 82.07 | 3.31 | 0.23 |
| 60 | 81.24 | 3.34 | 83.54 | 3.66 | 0.19 |
| 75 | 83.02 | 3.05 | 86.33 | 3.44 | 0.57 |
| 90 | 82.04 | 2.99 | 84.06 | 2.87 | 0.42 |

**Table 4: Hypotension in group 1 and group 2**

| | Group 1 | Group 2 |
|---|---|---|
| Number | 4 | 12 |
| Percentage | 11.43 | 34.29 |
| P value | 0.03 | |

**Table 5: Comparison of incidence of nausea, vomiting and shivering in both the groups**

| | Group 1 | | Group 2 | | P value |
|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | |
| Nausea | 2 | 5.71 | 3 | 8.57 | 0.002 |
| Vomiting | 2 | 5.71 | 4 | 11.43 | |
| Shivering | 3 | 8.57 | 7 | 20 | 0.004 |

## DISCUSSION

Spinal anaesthesia is a commonly used kind of anaesthesia in pregnant women scheduled for caesarean delivery. In addition, a conscious woman is given the chance to establish a connection with the infant shortly after delivery. Maternal hypotension is the most often seen consequence of spinal anaesthesia, arising from a reduction in arteriolar and venous tone due to sympathetic blockade. The use of vasopressors has been shown to enhance maternal cardiovascular stability. However, there is apprehension over the potential rise in afterload and the occurrence of baroreceptor-mediated bradycardia in mothers treated with phenylephrine, which may afterwards lead to a decrease in maternal cardiac output.[10-12]

The treatment of spinal hypotension under obstetric anaesthesia is a persistent challenge due to the need to consider the well-being of both the mother and foetus simultaneously. The prognostic outcomes for both the mother and the foetus after spinal anaesthesia are influenced by two important factors: the intensity and duration of hypotension. A multitude of strategies have been explored in the realm of mitigating spinal hypotension. The present study conducted a randomised controlled experiment to assess and compare the efficacy of two straightforward methods, namely preloading and leg wrapping, in the prevention of spinal hypotension after elective caesarean surgery. There were no significant differences seen between the patients recruited in both groups with regards to basic demographic and anthropometric data, including age, gender, height, and weight. Furthermore, the fundamental obstetric indicators, namely gravida and parity, exhibited a high degree of similarity between the two groups.

The heart rate in the preloading group exhibited statistically significant differences ($p<0.05$) when compared to the leg wrapping group at various time intervals. In a similar vein, Saranya Devi and colleagues detected a statistically significant disparity in heart rate across the several cohorts under investigation. The leg wrapping group had consistent heart rate levels before to and during delivery, whereas both the leg elevation group and control group saw an uptick in heart rate. The heart rates seen in both the leg elevation group and the control group were found to be significantly greater compared to the heart rates observed in the leg wrapping group.[13] The findings of our study also exhibited similar results, since the observed increase in heart rate may be understood as a compensatory reaction to low blood pressure, which was detected more often in the group that underwent leg wrapping. On the other hand, the increase in heart rate might perhaps be ascribed to the escalated use of ephedrine among individuals inside this specific cohort. In the current investigation, it was shown that around 11.43% of the patients in the preloading group had the occurrence of hypotension, while 34.29% of the patients in the leg wrapping group got hypotension. A total of four patients in Group 1 had hypotension and were given a dosage of 6 mg of ephedrine. Out of the 12 patients who had hypotension in Group B, 4 patients received a dosage of 6 mg of ephedrine, while the other 8 patients were administered a dosage of 12 mg of ephedrine. The occurrence of hypotension and the administration of ephedrine were found to be considerably greater ($p<0.05$) in the leg wrapping group compared to the preloading group. In a similar vein, Saranya Devi et al. observed that the group receiving leg wrapping had a reduced occurrence of hypotension and a decreased need for rescue vasopressor ephedrine in comparison to the leg elevation and control groups. Hypotension was seen in three patients (10%) in the leg wrapped group (BLW), ten patients (33.3%) in the leg lifted group


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(BLE), and fifteen patients (50%) in the control group (BC).[13]

Singh et al. observed that 43.33% of non-leg wrapped patients and 10% of leg wrapped patients had the development of hypotension, with a statistically significant correlation (P=0.009) to the findings of the present investigation.This finding is statistically significant and is consistent with the results of the present investigation.[14]

The studies conducted by Ramakrishnarao et al,[15] Hwang et al,[16] and Dyer et al,[17] are of academic significance. A significant increase ($P < 0.05$) in central venous pressure was seen by all participants throughout the preload phase. The findings of these investigations indicate that the prompt administration of crystalloid preload before spinal anaesthesia reduced the occurrence or intensity of hypotension.

The leg wrapping group exhibited a statistically significant ($p<0.05$) decrease in both systolic and diastolic blood pressure at various time points compared to the preloading group. In a similar vein, it was shown that the mean arterial pressure in the leg wrapping group exhibited a statistically significant decrease ($p<0.05$) at various time points when compared to the preloading group.

The present research's results align with those of Bhagawanje et al. who observed a statistically significant decrease in systolic arterial pressure in control volunteers at 4, 5, and 6 minutes after spinal injection, which is consistent with the findings of the current investigation. Additionally, the researchers observed that individuals with their legs wrapped had a much reduced incidence of hypotension (16.7%) compared to the control group (83.3%). In the leg wrapped group, only two patients necessitated the administration of ephedrine, but in the control group, this was needed by ten patients ($P = 0.0033$), thus demonstrating a correlation with the findings of the present research. The researchers also observed a reduction in the occurrence of nausea and vomiting associated with hypotension generated by spinal anaesthesia in patients undergoing elective caesarean section who had their legs wrapped. This finding is consistent with the findings of a previous study.[18]

Rout et al. demonstrated that in patients who underwent leg wrapping, there was no statistically significant drop in systolic pressure below the baseline value. The control group exhibited substantially lower systolic blood pressure compared to the group with leg wraps at the 3rd, 4th, 6th, 7th, and 10th minutes after spinal injection, which aligns with the findings of the present investigation. In addition, it was shown that 53% of patients who did not get leg wrapping had hypotension, whereas 18% of patients who received leg wrapping also suffered hypotension. In the study conducted on a group of patients who had their legs wrapped, it was seen that the odds ratio was 5.3 (95% confidence interval [CI] 1.7-16.3). This finding suggests that leg wrapping is associated with a significant reduction, about five-fold, in the occurrence of hypotension. This finding is consistent with the findings of the present investigation. A reduction in the occurrence of nausea and vomiting associated with hypotension generated by spinal anaesthesia was seen in patients undergoing elective caesarean section who had their legs wrapped. This finding is consistent with the results of the present investigation.[19]

In their investigation, Von Bogaert and colleagues observed a reduction in systolic blood pressure in both groups. However, it is noteworthy that the systolic blood pressure of patients with leg wrapping remained considerably higher than that of the control group, which aligns with the findings of the present study. The numerical value provided by the user is 13. The researchers also discovered that hypotension occurred in 45.5% of patients who did not have their legs wrapped, compared to 15.8% of patients who did have their legs wrapped ($\chi^2 = 11.02$, $P = 0.012$), indicating a statistically significant difference. This finding aligns with the results of the present study. The research found a reduction in the occurrence of nausea and vomiting associated with hypotension produced by spinal anaesthesia in patients undergoing elective caesarean section. This finding is consistent with the results of the present study.[20]

Bagle et al. conducted a research whereby they made observations indicating that the combination of leg wrapping and preloading resulted in a substantial decrease in the occurrence of hypotension and the need for vasopressors, as compared to preloading alone.[2] In a separate research conducted by Jamuna et al., a comparison was made between leg wrapping and leg elevation. The findings indicated that the leg wrapping group exhibited superior maintenance of hemodynamics in comparison to the leg elevation group. It is worth noting that both groups underwent preloading as part of the study protocol.[21] In their study, Adsumelli et al. utilised a sequential compression device to investigate its effects. They observed that a decrease of greater than 20% in mean arterial pressure (MAP) was observed in 52% of patients in the sequential compression device group, compared to 92% in the control group (p=0.004, odds ratio=0.094, 95% CI=0.018-0.488). This finding aligns with the current study. However, they did not find a significant difference in systolic and diastolic blood pressure, which contradicts the current study. It is possible that the intervention was implemented before the arterial pressure had the opportunity to reach its lowest point. Additionally, the researchers observed no statistically significant disparity in heart rate between the case and control groups, which does not align with the findings of this study. This discrepancy may be attributed to varying degrees of autonomic blockage.[22]

## CONCLUSION

The administration of intravenous crystalloids at a rate of 15ml/kg as a volume preloading technique demonstrates a significant reduction in the occurrence of spinal hypotension in comparison to


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the use of stretchy crepe bandages wrapped around the legs from the ankle to the mid thigh. The preloading group exhibited a decrease in the use of vasopressor medications as compared to the leg wrapping group. Preloading is considered the optimal strategy for preventing spinal hypotension and is strongly recommended. However, the incorporation of supplementary techniques such as leg wrapping and leg elevation, in conjunction with preloading, may potentially enhance hemodynamic stability to a greater extent.

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