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Comparison Of Passive Leg Raising And Intravenous Phenylephrine As Prophylaxis In Prevention Of Hypotension After Spinal Anaesthesia In Elective Caesarean Section - A Randomised Controlled Study

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I. Introduction

Cesarean section is the most commonly performed surgical delivery technique worldwide. The rates of cesarean section vary significantly across different countries and even between urban and rural areas, largely due to socioeconomic factors and varying levels of access to healthcare services. According to the World Health Organization (WHO), the optimal cesarean section rate should be between 5% and 15%. However, this rate can increase significantly when the reasons for cesarean sections are not well understood.

Maternal hypotension is a common complication following spinal anesthesia for cesarean sections, with an incidence of up to 60-70%. Postspinal hypotension (PSH) during cesarean sections has been associated with adverse maternal and fetal outcomes, with severe hypotension posing a serious risk to the mother. PSH mainly occurs due to a reduction in vascular tone, leading to decreased systemic vascular resistance and venous return. The prevention and management of PSH remain a key focus of ongoing research.

To reduce the incidence of hypotension, various strategies have been employed, including the administration of intravenous fluids and vasopressors such as ephedrine, phenylephrine, and norepinephrine. Mechanical techniques, such as leg compression and elevation, have also been used to increase vascular tone and venous return.

II. Aim

This study aims to compare the efficacy of passive leg raising versus intravenous phenylephrine in preventing hypotension following spinal anesthesia during elective cesarean sections.

III. Materials And Methods

This randomized controlled study was conducted in the Department of Anesthesia at Akash institute of medical sciences and research centre over a six-month period from January 2023 to June 2023. Ethical approval for the study was obtained from the Institutional Ethics Committee prior to its commencement.

The study enrolled 40 women scheduled for elective cesarean sections under spinal anesthesia. Participants were recruited based on the following inclusion criteria: age between 18 and 38 years, a full-term singleton pregnancy, and a planned elective cesarean delivery under spinal anesthesia. Exclusion criteria were defined as a history of cardiovascular disease (e.g., hypertensive disorders), multiple pregnancies, contraindications to spinal anesthesia, and any instance of a failed spinal block.

Participants were randomly assigned into two groups, each consisting of 20 patients, using a computer-generated randomization table to ensure unbiased allocation. Group A received intravenous phenylephrine as a prophylactic intervention, while Group B was subjected to passive leg raising. Written informed consent was obtained from all participants prior to their inclusion in the study, ensuring their full understanding of the study's objectives and procedures.

Group A (Intravenous Phenylephrine): Participants in this group received a prophylactic infusion of phenylephrine at a concentration of 100 mcg/ml. The phenylephrine was administered immediately after the confirmation of successful spinal anesthesia, with dosing titrated to maintain the mean arterial blood pressure (MAP) within 20% of the baseline pre-anesthesia values.

Group B (Passive Leg Raising): Participants in this group underwent passive leg raising as a mechanical intervention to enhance venous return. After the establishment of spinal anesthesia, the patient's legs were elevated to a 45-degree angle for 2 minutes. This maneuver was performed immediately post-induction of spinal anesthesia and was repeated as needed based on intraoperative hemodynamic assessments.

All patients received a standardized spinal anesthesia technique. Spinal anesthesia was administered in the sitting position at the L3-L4 interspace using a 25-gauge Quincke spinal needle. A dose of 2.0 to 2.2 ml of 0.5% hyperbaric bupivacaine was injected into the subarachnoid space. After the injection, patients were immediately placed in the supine position with a left uterine tilt to prevent aortocaval compression. The level of sensory block was assessed using the pinprick method, aiming for a T4-T6 level before the surgical incision.

Hemodynamic parameters, including heart rate (HR) and mean arterial pressure (MAP), were recorded at baseline (before spinal anesthesia) and at regular intervals of 5, 10, 20, 30, 40, and 50 minutes post-induction. The primary outcome was the incidence of hypotension, defined as a decrease in MAP greater than 20% from baseline.

Secondary outcomes included changes in heart rate, the need for additional vasopressors, and any maternal side effects such as nausea, vomiting, or bradycardia.

Data were analyzed using statistical software SPSS version 25.0. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. The comparison of continuous variables between the two groups was performed using an independent sample t-test. The chi-square test was used to compare categorical variables. A p-value of less than 0.05 was considered statistically significant.

IV. Results

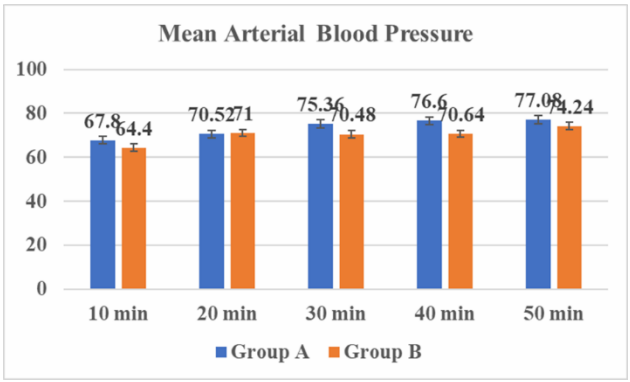
There was no significant difference in the demographic data of the two groups.

	Group A	Group B	P value
Age (yr)	27.64±4.0	27.40±3.7	0.87
Weight (kg)	77.16 ±3.2	76± 4.3	0.07
BMI	28.02± 2.31	28.07±4.0	0.061
Time of Surgery (min)	46.40 ±4.9	43.8 ±2.0	0.089

Heart rate was significantly reduced in Group A compared to Group B, with P<0.05, indicating that phenylephrine is effective in mitigating the tachycardia associated with hypotension.

	Group A	Group B	P value
Before Anaesthesia	88.36	91.04	0.29
After 5 min	79.72	87.32	0.001*
After 10 min	76.48	83.44	0.001*
After 20 min	73.76	79.4	0.001*
After 30 min	71.24	71.88	0.001*
After 40 min	67.12	74.23	0.001*
After 50 min	67.52	74.12	0.001*

There was a significant difference in mean arterial blood pressure between the groups, with P<0.05 (P=0.021).



V. Discussion

The management of maternal hypotension following spinal anesthesia for cesarean sections remains a critical issue in obstetric anesthesia, with significant implications for both maternal and fetal outcomes. This study aimed to compare the efficacy of passive leg raising with intravenous phenylephrine in preventing post-spinal hypotension (PSH) in patients undergoing elective cesarean sections. Our findings suggest that intravenous phenylephrine is more effective than passive leg raising in maintaining mean arterial pressure (MAP) and controlling heart rate, thereby reducing the incidence of PSH.

The incidence of hypotension following spinal anesthesia is well-documented, with reports indicating that up to 60-70% of patients experience significant hypotension during cesarean sections. The underlying cause is the sympathetic blockade induced by spinal anesthesia, which leads to a reduction in systemic vascular resistance (SVR) and venous return, resulting in decreased cardiac output. This study corroborates these findings, highlighting the necessity of effective prophylactic measures to mitigate the risk of hypotension and its associated complications.

In our study, patients who received intravenous phenylephrine (Group A) demonstrated a significantly better hemodynamic profile compared to those who underwent passive leg raising (Group B). The mean arterial pressure in Group A remained consistently higher across all time points, with a statistically significant difference observed at 10, 20, 30, 40, and 50 minutes post-anesthesia. Additionally, the heart rate was more effectively controlled in Group A, with a significant reduction observed compared to Group B. These findings align with the existing literature, which identifies phenylephrine as a potent vasopressor that effectively counteracts the vasodilatory effects of spinal anesthesia by increasing SVR without substantially affecting cardiac output.

Previous studies have consistently shown that phenylephrine is superior to other vasopressors, such as ephedrine, in maintaining blood pressure during cesarean sections under spinal anesthesia. This superiority is attributed to its α-adrenergic agonist activity, which causes vasoconstriction, thereby elevating blood pressure without causing significant tachycardia, a common side effect associated with other vasopressors. Our results are consistent with these studies, confirming phenylephrine's role as a first-line agent in the management of PSH.

On the other hand, the efficacy of passive leg raising as a prophylactic measure against PSH appears to be limited. While passive leg raising is a simple, non-invasive maneuver designed to increase venous return by shifting blood from the lower extremities to the central circulation, its impact on maintaining blood pressure in this study was minimal. The lack of significant hemodynamic improvement in Group B suggests that passive leg raising alone may be insufficient as a primary prophylactic strategy for PSH, particularly in the context of cesarean sections where the physiological demands on the cardiovascular system are heightened.

This finding is supported by earlier studies, such as those by Rout[2] et al., which indicated that while leg elevation might offer some benefit, it does not provide reliable protection against the profound hypotensive effects of spinal anesthesia in cesarean sections. Furthermore, the transient nature of the hemodynamic response to leg elevation may explain the limited efficacy observed in our study, as the maneuver may not sustain the necessary increase in venous return over the duration of the surgery.

The clinical implications of our findings are significant. Given the critical need to prevent maternal hypotension during cesarean sections to avoid adverse outcomes such as nausea, vomiting, dizziness, and compromised fetal oxygenation, our study supports the preferential use of intravenous phenylephrine over passive leg raising. By maintaining hemodynamic stability more effectively, phenylephrine not only improves maternal comfort but also enhances fetal well-being by ensuring adequate uteroplacental perfusion.

Moreover, our study suggests that while passive leg raising may have a role as an adjunctive measure, it should not be relied upon as the sole intervention for preventing PSH. Instead, it could be integrated into a multimodal approach that includes pharmacological agents like phenylephrine, particularly in patients at higher risk of hypotension.

Despite the strengths of our study, including its randomized controlled design, there are limitations that should be acknowledged. First, our study was conducted in a single center with a relatively small sample size, which may limit the generalizability of our findings. Larger, multicenter studies are needed to confirm our results and to explore the potential benefits of combining passive leg raising with other interventions.

Additionally, our study focused on non-invasive hemodynamic parameters, such as blood pressure and heart rate, which may not fully capture the complexities of maternal cardiovascular responses to spinal anesthesia. Future research could benefit from the use of advanced hemodynamic monitoring techniques, such as cardiac output measurement and invasive blood pressure monitoring, to provide a more comprehensive understanding of the effects of phenylephrine and passive leg raising on maternal and fetal outcomes.

Finally, while our study primarily focused on immediate intraoperative outcomes, the long-term effects of these interventions on maternal and neonatal health were not assessed. Future studies should consider evaluating the impact of these prophylactic strategies on postoperative recovery and neonatal outcomes to provide a more holistic assessment of their efficacy.

VI. Conclusion

In conclusion, our study demonstrates that intravenous phenylephrine is superior to passive leg raising in preventing post-spinal hypotension in patients undergoing elective cesarean sections. The findings highlight the importance of using effective pharmacological interventions to maintain hemodynamic stability during cesarean sections, thereby improving both maternal and fetal outcomes. Further research is warranted to explore the potential benefits of combining phenylephrine with other non-pharmacological measures and to assess the long-term effects of these interventions on maternal and neonatal health.

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