International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2024: 7.101

Phenylephrine versus Mephentermine in Spinal Anaesthesia- Induced Hypotension: An Updated Narrative Review

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Abstract: ***Background: A fall in blood pressure is the most frequent complication after spinal anaesthesia. This occurs mainly due to sympathetic block and may compromise tissue perfusion if not promptly recognized. Vasopressors form the cornerstone of management. Phenylephrine and mephentermine are among the commonly employed agents, but the relative clinical advantages of each remain an area of discussion. Aim: To summarize available literature comparing phenylephrine and mephentermine in the treatment of spinal anaesthesia–related hypotension, with emphasis on haemodynamic responses and adverse effects. Methods: Relevant clinical trials, comparative studies and reviews were identified from PubMed, Google Scholar and major anaesthesia journals. Studies evaluating the two drugs during spinal anaesthesia were reviewed. Haemodynamic parameters such as blood pressure, heart rate, need for rescue vasopressors and complications were examined. Results: Both vasopressors successfully restore arterial pressure during hypotensive episodes. Phenylephrine acts primarily through α_1-receptor stimulation producing rapid vasoconstriction, but it is frequently associated with reflex slowing of heart rate and possible reduction in cardiac output. Mephentermine exerts both α- and β-adrenergic actions and tends to maintain heart rate and cardiac output, with a steadier though slightly slower pressor effect. Many studies report more bradycardia and a greater need for additional doses with phenylephrine. Conclusion: No single agent is universally superior. Phenylephrine is useful when an immediate rise in blood pressure is required or when tachycardia is undesirable. Mephentermine may be favoured when preservation of heart rate and cardiac output is a priority. Individual patient characteristics should guide drug selection.***

Keywords: spinal anaesthesia, vasopressor, mephentermine, phenylephrine, hypotension

1. Introduction

Spinal anaesthesia is widely chosen for lower abdominal, pelvic, perineal and lower-limb procedures owing to its simplicity, rapid onset and excellent surgical conditions. Despite these benefits, hypotension is the most common physiological disturbance seen after the block. Sympathetic blockade causes venodilatation, reduced venous return, diminished stroke volume and a fall in systemic vascular resistance, resulting in decreased arterial pressure. In severe cases, reduced perfusion of vital organs may occur, leading to symptoms such as dizziness, nausea, myocardial ischaemia or foetal compromise[1,2].

General preventive measures such as fluid administration and positioning may reduce the incidence, but once hypotension occurs, pharmacological support is often required. Vasopressors provide rapid correction of blood pressure and remain central to management. Phenylephrine and mephentermine are widely used in daily practice, particularly in resource-limited settings where they are readily available.

Phenylephrine is almost purely α-adrenergic in action, whereas mephentermine exhibits mixed α- and β-agonism. These differences lead to distinct haemodynamic patterns. Understanding their pharmacology and clinical evidence helps clinicians choose the appropriate agent for individual patients.

Mechanism of Hypotension after Spinal Anaesthesia
Spinal anaesthesia results in blockade of preganglionic sympathetic fibres. Consequences include:

- Dilation of arterial and venous capacitance vessels
- Pooling of blood in the lower extremities and splanchnic circulation
- Reduction in venous return and cardiac filling
- Decreased stroke volume and cardiac output[3]

Bradycardia can accompany hypotension because of:

- Blockade of cardiac accelerator fibres (T1–T4)
- Activation of the Bezold–Jarisch reflex due to reduced ventricular volume
- Predominant vagal tone

The magnitude of hypotension depends on the level of block, intravascular status, patient age and co-existing disease.

Phenylephrine: Pharmacology and Clinical Profile
Phenylephrine is a potent selective α_1-adrenergic receptor agonist with negligible β-activity. Its principal effect is intense peripheral vasoconstriction, which increases systemic vascular resistance and restores blood pressure rapidly. However, activation of baroreceptors often leads to reflex bradycardia, which may in turn decrease cardiac output, particularly in hypovolaemic patients[4].

Typical clinical use

- IV bolus 50–100 µg
- optional infusion titrated to effect

Potential adverse effects

- reflex bradycardia
- reactive hypertension
- reduction in cardiac output

- headache or restlessness in high doses

Mephentermine: Pharmacology and Clinical Profile

Mephentermine is an indirectly acting sympathomimetic. It promotes release of norepinephrine from nerve terminals and stimulates both **α- and β-adrenergic receptors**.

Haemodynamic consequences include:

- Vasoconstriction through α-receptor activation
- Increased heart rate and contractility via β-receptor action
- Relative preservation or increase in cardiac output

The usual IV bolus dose is **6 mg**, repeated as required. Side effects such as tachycardia or palpitations may occur but are uncommon when recommended doses are respected[5,6].

Summary of Important Comparative Studies

Jain et al. (2011) investigated obstetric patients receiving spinal anaesthesia for caesarean delivery. Both drugs were effective in treating hypotension; however, phenylephrine caused significantly more bradycardia, while mephentermine maintained heart rate more consistently[1].

Sahoo et al. (2012) reported faster restoration of systolic pressure with phenylephrine, whereas mephentermine provided steadier haemodynamic control with fewer bradycardic episodes[2].

Kumar et al. (2013) evaluated non-obstetric lower abdominal procedures and noted similar blood-pressure control in both groups, but a greater number of rescue doses were required in those receiving phenylephrine, potentially due to heart-rate reduction limiting further administration[3].

Kothari (2015) observed that phenylephrine was associated with reflex bradycardia and occasional hypertension, while mephentermine better preserved cardiac output and heart rate[4].

The review by Ngan Kee (2017) emphasized tailoring vasopressor choice to patient needs; phenylephrine is favoured when tachycardia is undesirable, while mephentermine is useful when cardiac output preservation is desired[5].

Overall, literature consistently demonstrates effective pressure control with both drugs, but distinct chronotropic responses.

Table 1: Key Studies Comparing Phenylephrine and Mephentermine

Author & Year	Population	Sample Size	Regimen	Principal Findings
Jain et al., 2011	Obstetric	90	PHE 50–100 µg vs MEPH 6 mg	More bradycardia with phenylephrine; HR stability with mephentermine
Sahoo et al., 2012	Obstetric	100	Bolus dosing	Phenylephrine faster BP rise; mephentermine more stable
Kumar et al., 2013	Non-obstetric	60	Standard bolus	Rescue doses higher with phenylephrine
Kothari, 2015	Mixed	80	Routine dosing	Phenylephrine → bradycardia; mephentermine preserved HR/CO
Ngan Kee, 2017	Review	—	—	Drug should be individualized based on HR and CO

PHE = phenylephrine; MEPH = mephentermine; BP = blood pressure; HR = heart rate; CO = cardiac output

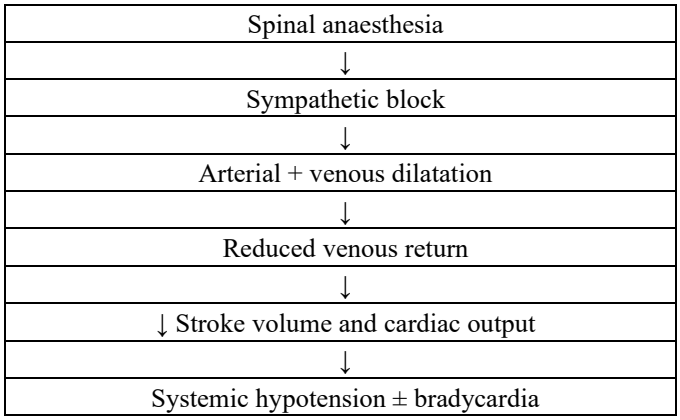
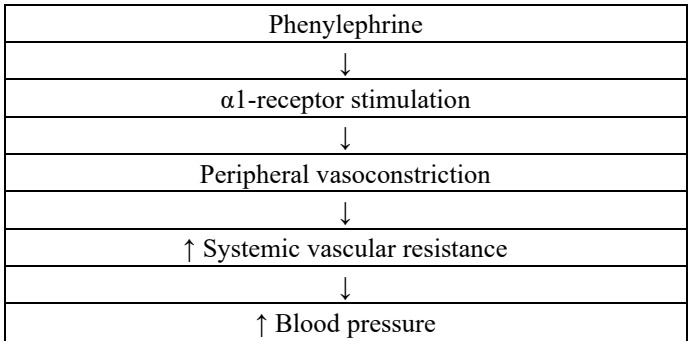


Figure 1. Pathway leading to hypotension after spinal anaesthesia



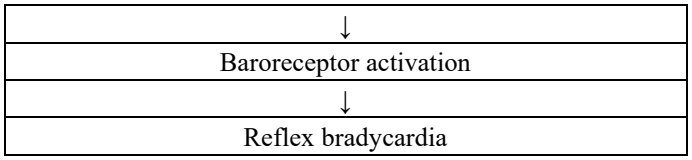


Figure 2: Mechanism of phenylephrine

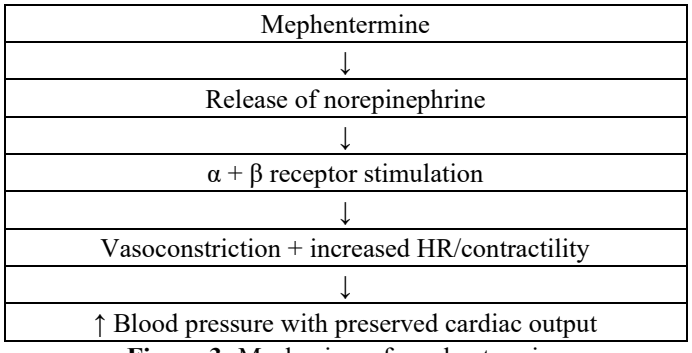


Figure 3: Mechanism of mephentermine

Clinical Relevance

Phenylephrine:

- Rapid onset
- Useful where tachycardia is harmful
- May reduce heart rate and cardiac output

Mephentermine:
- Steadier haemodynamic profile
- Maintains heart rate and cardiac output
- Useful in young or hypovolaemic patients

Thus, clinical setting and patient physiology should guide drug selection rather than a universal preference.

Advantages of Available Evidence
- multiple randomized and comparative studies
- reproducible observations regarding bradycardia and heart rate trends
- inclusion of both obstetric and non-obstetric populations

Limitations of Current Literature
- many studies include small sample sizes
- variation in dosing protocols between trials
- predominance of obstetric populations
- limited reporting of long-term postoperative outcomes

2. Future Perspectives

Further research should focus on:
- Larger, multicentre trials
- Head-to-head comparison with newer vasopressors
- Standardized haemodynamic outcome measures
- Incorporation of cardiac output monitoring techniques

3. Conclusion

Phenylephrine and mephentermine are both effective agents for the treatment of hypotension following spinal anaesthesia. Phenylephrine produces a swift rise in blood pressure but is frequently associated with reflex bradycardia and possible reduction in cardiac output. Mephentermine maintains heart rate and cardiac output while providing effective pressor support. Drug choice should be individualized based on the clinical situation, anticipated haemodynamic responses, and patient factors.

Ethical Consideration
This is a review of previously published literature; therefore, ethical committee approval and informed consent were not required.

Conflict of Interest
No conflict of interest is declared by the authors.

Funding
This research received no external financial support.

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