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Efficacy of Prophylactic Phenylephrine in Preventing Post-Arachnoid Hypotension During Elective Urological Surgeries

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Abstract

Background: Spinal anaesthesia is frequently associated with hypotension due to sympathetic blockade, which can lead to serious complications, especially in urological procedures. Phenylephrine, a selective α_1-adrenergic agonist, has been studied as a prophylactic vasopressor to counteract this drop in blood pressure.

Aim: To evaluate the effectiveness of intramuscular (IM) phenylephrine in preventing spinal anaesthesia-induced hypotension in normotensive patients undergoing elective urological surgeries.

Material and Methods: A randomized, double-blind, controlled study was conducted on 50 normotensive patients aged 18–65 years scheduled for elective urological surgeries. Patients were

randomly allocated into two groups: Group P received 2 mg IM phenylephrine 10 minutes before spinal anaesthesia, while Group C received no prophylactic vasopressor. Hemodynamic parameters were recorded at baseline and at regular intervals up to 15 minutes post spinal block. Hypotension was defined as a ≥20% fall in systolic blood pressure or SBP <90 mmHg.

Results: The incidence of hypotension was significantly lower in Group P (8%) compared to Group C (44%). Group P maintained higher systolic blood pressure levels at 4-, 6-, and 8-minutes post spinal anaesthesia, with statistically significant differences ($p<0.05$). No significant adverse effects were observed in either group.

Conclusion: Prophylactic intramuscular phenylephrine is effective in preventing hypotension following spinal anaesthesia in normotensive patients undergoing urological surgeries. Its ease of administration, safety, and efficacy make it a valuable alternative, especially in resource-limited settings.

Keywords: Spinal anaesthesia, Hypotension, Phenylephrine, Intramuscular injection, Urological surgeries

Introduction

Spinal anaesthesia (SA) is a widely preferred technique for lower abdominal and urological surgeries due to its simplicity, rapid onset, and superior sensory-motor blockade. However, it is commonly associated with significant hypotension resulting from sympathetic blockade and venous pooling [1]. This drop in blood pressure may lead to dizziness, nausea, and even decreased organ perfusion, particularly concerning in elderly or cardiovascularly vulnerable patients [2]. To mitigate this risk, vasopressors such as phenylephrine—a selective α_1-adrenergic agonist—have been employed either prophylactically or therapeutically [3].

Phenylephrine works by causing peripheral vasoconstriction, thereby increasing systemic vascular resistance and stabilizing arterial pressure [4]. Traditionally administered intravenously, intramuscular (IM) phenylephrine is emerging as a practical and less resource-intensive alternative, especially in settings with limited continuous monitoring [5]. Recent studies suggest that IM phenylephrine not only provides hemodynamic stability but also reduces the incidence of reactive bradycardia often seen with bolus IV dosing [6].

The urological patient population—often older and with associated comorbidities—represents a high-risk group for spinal-induced hypotension [7]. Hence, identifying a safe, effective, and easily administered prophylactic agent is essential to optimize perioperative outcomes. Despite growing interest, evidence comparing IM phenylephrine to placebo in such surgical contexts remains limited.

Several randomized controlled trials in recent years have explored the role of prophylactic vasopressors in neuraxial blocks, highlighting the evolving dynamics of preemptive hemodynamic modulation [8,9]. In particular, research is now focusing on tailoring vasopressor choice, route, and dose according to patient risk profiles and surgical demands [10].

This study aims to evaluate the effectiveness of intramuscular phenylephrine compared to placebo in preventing hypotension following spinal anaesthesia in normotensive patients undergoing elective urological procedures. The findings may offer insights into enhanced intraoperative stability and guide standardized prophylaxis protocols.

Material and Methods

This study was a randomized, double-blind, placebo-controlled clinical trial conducted in the Department of Anaesthesiology at a tertiary care hospital over a period of 12 months. A total of 50 normotensive patients

aged between 18 and 65 years, scheduled for elective urological surgeries under spinal anaesthesia, were included in the study. Patients were randomly divided into two equal groups of 25 each:

- Group P (Phenylephrine group): Received 2 mg intramuscular phenylephrine 10 minutes prior to spinal anaesthesia.
- Group C (Control group): Received no prophylactic vasopressor (placebo).

Inclusion Criteria

- Adult patients aged 18–65 years
- American Society of Anesthesiologists (ASA) physical status I and II
- Scheduled for elective urological surgeries under spinal anaesthesia
- Normotensive with no antihypertensive therapy

Exclusion Criteria

- Patients with known cardiovascular, renal, or hepatic disease
- Patients on chronic antihypertensive or vasoactive drugs
- Allergy or contraindication to phenylephrine
- BMI >30 kg/m²
- Pregnant or lactating women
- Emergency surgeries

Block randomization was used to allocate patients into the two groups. Allocation concealment was maintained using sealed opaque envelopes. Both the administering anaesthesiologist and the observer collecting data were blinded to the group assignments to ensure objectivity.

All patients were preloaded with 10 mL/kg of Ringer lactate solution. Group P received 2 mg of phenylephrine intramuscularly 10 minutes before the administration of spinal anaesthesia, while Group C received no prophylactic drug. Spinal anaesthesia was performed in the sitting position at the L3–L4

interspace using 0.5% hyperbaric bupivacaine.

Non-invasive blood pressure, heart rate, respiratory rate, and oxygen saturation were monitored at baseline and then every 2 minutes for the first 20 minutes post-spinal, followed by every 5 minutes until the end of the procedure. Hypotension was defined as a fall in systolic blood pressure ≥20% from baseline or <90 mmHg and was managed with intravenous fluids and additional vasopressors as needed.

Primary Outcome:

- Incidence of hypotension following spinal anaesthesia.

Secondary Outcomes:

- Requirement of rescue vasopressors
- Intraoperative heart rate variations
- Incidence of nausea, vomiting, and bradycardia

Statistical analysis

The recorded data was compiled and entered in a spreadsheet computer program and then exported to data editor page of SPSS version 15. Quantitative variables were described as means and standard deviations or median and interquartile range based on their distribution. Qualitative variables were presented as count and percentages. For all tests, confidence level and level of significance were set at 95% and 5% respectively.

Results

Table 1 shows the baseline characteristics of patients in both groups. The mean age in Group P was 51.10 ± 10.82 years and in Group C was 50.65 ± 10.95 years, indicating a comparable age distribution. All participants were male in both groups with a male-to-female ratio of 25:0. ASA physical status was evenly spread, with Group P having 13 patients classified as ASA I and 12 as ASA II, while Group C had 12 patients as ASA I and 13 as ASA II. Baseline heart rate was slightly lower in the phenylephrine group (76.12 ± 9.10 bpm) compared to the

control group (84.90 ± 9.41 bpm). The baseline systolic blood pressure was also similar in both groups, and the sensory dermatomal level achieved with spinal anaesthesia was around T9 in both groups, indicating uniformity in block levels.

Table 2 shows the comparison of mean systolic blood pressure at various time intervals between the two groups. At baseline, 0 minutes, and 2 minutes, there was no statistically significant difference in systolic blood pressure between Group P and Group C. However, at 4 minutes, Group C showed a notable drop in pressure (106.80 ± 13.40 mm Hg) compared to Group P (115.10 ± 14.40 mm Hg), which was statistically significant. This trend continued with high significance at 6 minutes, where Group P maintained 109.20 ± 14.70 mm Hg, while Group C dropped to 98.85 ± 12.00 mm Hg. At 8 minutes, the difference remained significant. Although some drop in values persisted at 10, 12, and 15 minutes, the differences were not statistically significant, showing eventual stabilization of blood pressure in both groups but better early preservation in Group P.

Table 3 highlights the effectiveness of intramuscular phenylephrine in preventing spinal anaesthesia-induced hypotension. In Group P, only 2 patients (8%) developed hypotension, whereas in Group C, 11 patients (44%) experienced hypotensive episodes. This significant reduction in hypotension incidence in the phenylephrine group clearly demonstrates the benefit of prophylactic vasopressor use in maintaining hemodynamic stability.

Table 1: Distribution of patients according to baseline data

Characteristic	Group P	Group C
Age (mean±SD)	51.10 ± 10.82 years	50.65 ± 10.95 years
Sex (M:F)	25:0	25:0

ASA Status (I:II)	13:12	12:13
Baseline HR (mean±SD)	76.12 ± 9.10 bpm	84.90 ± 9.41 bpm
Baseline SBP (mean±SD)	120.50 ± 11.15 mm Hg	120.80 ± 12.18 mm Hg
Sensory dermatomal level	T9 (T8–T10)	T9 (T8–T10)

Table 2: Comparison of Mean Systolic Blood Pressure at Various Time Intervals in Group P and Group C

Time	Group P (mean ± SD)	Group C (mean ± SD)	't' value	Significance
Baseline	120.50 ± 11.15	120.80 ± 12.18	0.06	Not significant
0 minutes	121.85 ± 13.90	123.00 ± 12.11	0.36	Not significant
2 minutes	118.40 ± 13.62	116.20 ± 11.20	-0.62	Not significant
4 minutes	115.10 ± 14.40	106.80 ± 13.40	-2.30	Significant
6 minutes	109.20 ± 14.70	98.85 ± 12.00	-2.94	Highly significant
8 minutes	108.60 ± 14.60	101.20 ± 10.40	-2.15	Significant
10 minutes	109.00 ± 13.80	103.30 ± 9.30	-1.86	Not significant
12 minutes	109.10 ± 14.10	105.10 ± 9.50	-1.30	Not significant
15 minutes	109.40 ± 13.60	106.70 ± 9.30	-0.98	Not significant

Table 3: Effect of IM Phenylephrine Against Spinal Anesthesia-Induced Hypotension

Parameter	Group P	%	Group C	%
Hypotension seen	2	8.00%	11	44.00%
Hypotension not seen	23	92.00%	14	56.00%
Total	25	100.0	25	100.0

Discussion

Spinal anaesthesia is frequently accompanied by hypotension due to sympathetic blockade and vasodilation, particularly concerning in urological surgeries where patients are often elderly or volume-depleted. The findings of the present study indicate that prophylactic intramuscular phenylephrine significantly reduces the incidence of spinal-induced hypotension in normotensive patients undergoing elective urological procedures.

Our results show that Group P (phenylephrine group) maintained more stable systolic blood pressure readings during the first 10 minutes following spinal anaesthesia compared to Group C. This aligns with the findings of Cooper et al. [4] and Senthilnathan et al. [5], who emphasized phenylephrine's efficacy in preserving blood pressure following neuraxial blockade. The most critical hypotensive episodes in the control group were noted between the 4th and 8th minutes post spinal block, which is consistent with the peak sympathectomy phase [12].

Importantly, the incidence of hypotension was only 8% in the phenylephrine group, compared to 44% in the control group, confirming the preventive value of IM phenylephrine. Similar outcomes were reported by Liu et al. [6] in a trial comparing IM and IV phenylephrine, where the IM group showed better hemodynamic steadiness and fewer episodes requiring rescue intervention.

The use of IM administration offers several advantages—it provides a gradual onset and sustained plasma levels of phenylephrine, avoiding the rapid spikes and troughs associated with IV boluses [13]. This method is particularly practical in low-resource settings where continuous infusion pumps are

unavailable, and real-time invasive monitoring may be limited [14].

Additionally, the absence of bradycardia or adverse effects related to phenylephrine in our study population further supports its safety profile. This contrasts with some earlier literature reporting reflex bradycardia, likely linked to IV administration rather than the slower IM route [15]. Our findings suggest that a single IM dose is sufficient for the short duration of spinal-induced hypotension and may reduce the overall need for rescue vasopressors.

Overall, the use of IM phenylephrine represents a simple, low-cost, and effective intervention to manage spinal hypotension, and it could be considered for broader use in clinical practice, especially in patients undergoing short-duration surgeries like urological procedures.

Conclusion

Prophylactic intramuscular phenylephrine significantly reduces the incidence and severity of hypotension following spinal anaesthesia in normotensive patients undergoing elective urological surgeries. Its safety, ease of administration, and effectiveness make it a valuable preemptive strategy, particularly in resource-limited settings. Wider implementation may improve hemodynamic stability and perioperative outcomes in routine urological anaesthetic practice.

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