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Incidence and Predictors of Hypotension Following Spinal Anaesthesia in A Tertiary Care Hospital

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ABSTRACT

Background: Spinal anaesthesia is a commonly employed regional anaesthetic technique for infra-umbilical surgeries due to its simplicity and effectiveness. However, hypotension remains the most frequent and clinically significant complication associated with spinal anaesthesia, potentially leading to adverse perioperative outcomes.
Objectives: To determine the incidence of hypotension following spinal anaesthesia and to identify patient- and procedure-related predictors associated with its occurrence in a tertiary care hospital.
Materials and Methods: This prospective observational study was conducted in the Department of Anaesthesiology of a tertiary care teaching hospital over a period of six months. A total of 120 adult patients aged 18–75 years, belonging to ASA physical status I–III and undergoing elective lower abdominal or lower limb surgeries under spinal anaesthesia, were included. Baseline demographic variables, hemodynamic parameters, intrathecal bupivacaine dose, and sensory block height were recorded. Hypotension was defined as a decrease in systolic blood pressure of ≥20% from baseline or an absolute systolic blood pressure <90 mmHg. Data were analyzed using univariate and multivariate logistic regression to identify independent predictors.
Results: Hypotension occurred in 38 out of 120 patients, giving an incidence of 31.7%. On univariate analysis, age >60 years, baseline systolic blood pressure <120 mmHg, and sensory block level ≥T6 were significantly associated with hypotension ($p < 0.05$). Multivariate logistic regression identified age >60 years (OR 2.3), lower baseline systolic blood pressure (OR 2.5), and higher sensory block level (OR 2.9) as independent predictors.
Conclusion: Hypotension following spinal anaesthesia is common and multifactorial. Advanced age, lower baseline systolic blood pressure, and higher sensory block level are significant predictors. Awareness of these factors can aid in early risk stratification and improve perioperative hemodynamic management.

Keywords*: Spinal anaesthesia; Hypotension; Predictors; Hemodynamic changes; Regional anaesthesia.*

INTRODUCTION:

Spinal anaesthesia is one of the most frequently employed regional anaesthetic techniques for infra-umbilical surgical procedures due to its rapid onset, dense sensory and motor blockade, reduced airway manipulation, and cost-effectiveness. It is commonly preferred for lower abdominal, urological, gynecological, and orthopedic surgeries, particularly in tertiary care hospitals where high surgical volumes demand reliable and efficient anaesthetic techniques [1].

Despite its widespread use and favorable safety profile, spinal anaesthesia is associated with several physiological alterations, the most significant being hypotension. The reported incidence of hypotension following spinal anaesthesia varies widely, ranging from 20% to 60%, depending on patient characteristics, anaesthetic technique, definition used, and

type of surgery performed [2,3]. Hypotension following spinal anaesthesia is primarily attributed to sympathetic blockade resulting in peripheral vasodilatation, reduced systemic vascular resistance, venous pooling, and a consequent decrease in venous return and cardiac output [4].

Clinically significant hypotension can lead to symptoms such as nausea, vomiting, dizziness, and discomfort, and in severe cases may compromise coronary, cerebral, and renal perfusion. In elderly patients and those with limited cardiovascular reserve, even transient hypotension may result in serious perioperative morbidity [5]. Therefore, early recognition and prompt management of spinal anaesthesia–induced hypotension remain critical components of perioperative care.

Several patient-related and anaesthesia-related factors have been implicated in the development of hypotension following spinal anaesthesia. Advanced age has consistently been shown to increase susceptibility due to age-related decline in autonomic nervous system responsiveness and impaired baroreceptor reflexes [6]. Baseline hemodynamic status, particularly lower preoperative systolic blood pressure, has also been identified as an important predictor [7]. Other factors such as female sex, body mass index, presence of comorbidities, intrathecal local anaesthetic dose, and use of adjuvants may further influence the incidence and severity of hypotension [8].

The extent of sympathetic blockade is closely related to the height of the sensory block achieved. Higher sensory block levels, particularly at or above the T6 dermatome, are associated with greater degrees of vasodilatation and hypotension due to blockade of cardiac accelerator fibers originating from T1–T4 segments [9]. Variations in block height may occur due to differences in patient anatomy, baricity of local anaesthetic solution, patient positioning, and total drug dose administered [10].

Although numerous studies have evaluated spinal anaesthesia–induced hypotension, there is considerable heterogeneity in reported predictors across different populations and healthcare settings. Moreover, most available data originate from obstetric populations, while limited evidence is available from mixed adult surgical cohorts in tertiary care hospitals in developing countries [11]. Institutional variations in patient demographics, anaesthetic practices, and perioperative management protocols necessitate locally generated data to guide risk stratification and preventive strategies.

Identifying predictors of hypotension following spinal anaesthesia is essential for optimizing patient selection, tailoring anaesthetic techniques, and instituting timely prophylactic measures such as judicious fluid administration, dose modification, and early vasopressor use. With this background, the present study was designed to determine the incidence of hypotension following spinal anaesthesia and to identify significant patient- and procedure-related predictors in adult patients undergoing surgery in a tertiary care hospital.

MATERIALS AND METHODS:

Study Design

This was a **prospective observational study** conducted to evaluate the incidence and predictors of hypotension following spinal anaesthesia in adult surgical patients.

Study Setting

The study was carried out in the **Department of Anaesthesiology** of a tertiary care teaching hospital, including patients undergoing elective surgeries under spinal anaesthesia in the operation theatres.

Study Duration

The study was conducted over a period of **six months**

Study Population

Adult patients scheduled for elective lower abdominal and lower limb surgeries under spinal anaesthesia were screened for eligibility.

Sample Size: A total of **120 patients** were enrolled in the study.

Inclusion Criteria

- Patients aged **18 to 75 years**
- American Society of Anesthesiologists (ASA) physical status **I to III**
- Patients undergoing **elective lower abdominal or lower limb surgeries**
- Patients receiving spinal anaesthesia as the sole anaesthetic technique
- Patients who provided written informed consent

Exclusion Criteria

- Patient refusal for spinal anaesthesia
- Emergency surgical procedures
- Contraindications to spinal anaesthesia (coagulopathy, infection at injection site, raised intracranial pressure)

- Patients with known autonomic neuropathy
- Severe valvular heart disease or cardiomyopathy
- Patients receiving combined spinal–epidural anaesthesia
- Incomplete data or failed spinal block

Preoperative Assessment

All patients underwent a detailed preanaesthetic evaluation, which included:

- Demographic data (age, sex, body mass index)
- Medical history and comorbidities
- Physical examination
- Baseline vital parameters including heart rate, systolic and diastolic blood pressure
- ASA physical status classification

Baseline blood pressure was recorded as the **average of two readings** taken five minutes apart in the supine position before administering spinal anaesthesia.

Anaesthetic Technique

On arrival in the operating theatre, standard monitoring was applied, including:

- Non-invasive blood pressure (NIBP)
- Electrocardiography (ECG)
- Pulse oximetry

An intravenous line was secured using an 18G cannula, and patients received preload with crystalloid solution as per institutional protocol.

Spinal anaesthesia was administered in the **sitting position** under strict aseptic precautions at the **L3–L4 or L4–L5 intervertebral space** using a **25-gauge Quincke spinal needle**. After confirmation of free flow of cerebrospinal fluid, **hyperbaric bupivacaine (10–15 mg)** was injected intrathecally. The dose was individualized based on patient height, age, and surgical requirement.

Following spinal injection, patients were immediately positioned supine.

Assessment of Sensory Block

The level of sensory blockade was assessed using the **loss of pin-prick sensation** method along the mid-clavicular line. The maximum sensory block height achieved was recorded and categorized as:

- Below T6
- At or above T6

Hemodynamic Monitoring

Blood pressure and heart rate were recorded:

- Every **2 minutes for the first 20 minutes**
- Every **5 minutes thereafter** until the end of surgery

Definition and Management of Hypotension

Hypotension was defined as:

- A **decrease in systolic blood pressure ≥20% from baseline**, **or**
- An absolute systolic blood pressure **<90 mmHg**

When hypotension occurred, it was managed according to institutional protocol using:

- Intravenous fluid boluses
- Vasopressors (e.g., ephedrine or phenylephrine)
- Supplemental oxygen when required

The occurrence and timing of hypotension were documented.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using **Statistical Package for Social Sciences (SPSS)** software 20.0.

- Continuous variables were expressed as **mean ± standard deviation**
- Categorical variables were expressed as **frequency and percentage**
- Univariate analysis was performed using **Chi-square test** or **Student's t-test** as appropriate
- Variables with $p < 0.05$ in univariate analysis were included in **multivariate logistic regression analysis** to identify independent predictors of hypotension
- A p-value **<0.05** was considered statistically significant

Ethical Considerations
The study was initiated after obtaining approval from the **Institutional Ethics Committee**. Written informed consent was obtained from all participants. Patient confidentiality was maintained throughout the study.

RESULTS:
A total of **120 patients** undergoing elective surgeries under spinal anaesthesia were included in the study. All patients completed the study protocol and were analyzed.

The study population consisted predominantly of middle-aged adults with a slight male predominance. Baseline hemodynamic parameters were within normal limits in the majority of patients as shown in table 1

Table 1: Demographic and Baseline Characteristics of the Study Population

Variable	Value
Total patients	120
Mean age (years)	50.8 ± 13.9
Age >60 years	38 (31.7%)
Male	63 (52.5%)
Female	57 (47.5%)
Mean BMI (kg/m²)	24.6 ± 3.8
ASA I	54 (45.0%)
ASA II	46 (38.3%)
ASA III	20 (16.7%)
Mean baseline systolic BP (mmHg)	124 ± 13
Mean baseline diastolic BP (mmHg)	78 ± 9

Hypotension following spinal anaesthesia was observed in nearly one-third of patients. Most episodes occurred within the first 20 minutes after intrathecal drug administration as shown in table 2.

Table 2: Incidence of Hypotension

Outcome	Number (%)
Hypotension present	38 (31.7%)
No hypotension	82 (68.3%)
Total	120 (100%)

Most patients received intrathecal bupivacaine doses between 10 and 12.5 mg. A higher sensory block level (≥T6) was achieved in approximately one-third of patients as shown in table 3.

Table 3: Anaesthesia-Related Characteristics

Variable	Value
Mean bupivacaine dose (mg)	12.2 ± 1.6
Dose ≥12.5 mg	39 (32.5%)
Sensory block <T6	81 (67.5%)
Sensory block ≥T6	39 (32.5%)

Patients aged more than 60 years and those with lower baseline systolic blood pressure showed a significantly higher incidence of hypotension following spinal anaesthesia as shown in table 4.

Table 4: Association of Patient-Related Factors with Hypotension

Variable	Hypotension (n=38)	No Hypotension (n=82)	p value
Age >60 years	17 (44.7%)	21 (25.6%)	0.03
Female sex	19 (50.0%)	38 (46.3%)	0.69
BMI ≥25 kg/m²	14 (36.8%)	26 (31.7%)	0.57
Baseline SBP <120 mmHg	19 (50.0%)	22 (26.8%)	0.01

A higher sensory block level (≥T6) showed a strong association with hypotension, while higher intrathecal drug dose showed a trend toward increased hypotension but did not reach statistical significance as shown in table 5.

Table 5: Association of Anaesthesia-Related Factors with Hypotension

Variable	Hypotension (n=38)	No Hypotension (n=82)	p value
Sensory block ≥T6	21 (55.3%)	18 (22.0%)	<0.001
Bupivacaine ≥12.5 mg	16 (42.1%)	23 (28.0%)	0.12

Variables that were statistically significant on univariate analysis were included in multivariate logistic regression. Advanced age, lower baseline systolic blood pressure, and higher sensory block level emerged as independent predictors of hypotension as shown in table 6

Table 6: Independent Predictors of Hypotension (Multivariate Analysis)

Predictor	Odds Ratio	95% Confidence Interval	p value
Age >60 years	2.3	1.1–4.9	0.04
Baseline SBP <120 mmHg	2.5	1.2–5.1	0.02
Sensory block ≥T6	2.9	1.4–6.0	0.003

DISCUSSION:

Spinal anaesthesia is a widely practiced regional anaesthetic technique; however, hypotension remains its most frequent and clinically relevant complication. The present study evaluated the incidence of hypotension following spinal anaesthesia and identified significant predictors in adult patients undergoing elective surgeries in a tertiary care hospital.

In this study, hypotension was observed in **31.7%** of patients. This incidence is comparable with previous studies, where reported rates range from **25% to 40%** in non-obstetric adult populations [12,13]. Variations in incidence across studies can be attributed to differences in patient demographics, definitions of hypotension, intrathecal drug doses, and perioperative management protocols.

Age as a Predictor of Hypotension

Advanced age was found to be a significant independent predictor of hypotension in the present study. Patients aged more than 60 years had a higher incidence of hypotension compared to younger patients. Age-related decline in autonomic nervous system responsiveness, reduced baroreceptor sensitivity, and decreased cardiovascular reserve may explain this association. Similar findings have been reported by Hartmann et al. and Nair et al., who demonstrated a significantly higher risk of spinal anaesthesia–induced hypotension in elderly patients [14,15]. These findings highlight the need for careful hemodynamic monitoring and individualized anaesthetic dosing in older patients.

Baseline Systolic Blood Pressure

Lower baseline systolic blood pressure was identified as an independent predictor of hypotension. Patients with preoperative systolic blood pressure below 120 mmHg were more likely to develop hypotension after spinal anaesthesia. This observation is consistent with earlier studies that have emphasized baseline hemodynamic status as an important determinant of post-spinal hypotension [16,17]. Patients with lower baseline blood pressure may have limited compensatory mechanisms to counteract sympathetic blockade, making them more susceptible to hypotension.

Sensory Block Height

The present study demonstrated a strong association between higher sensory block levels (≥T6) and hypotension. A higher level of sympathetic blockade leads to extensive vasodilatation and reduced venous return. Additionally, blockade of cardiac accelerator fibers originating from T1–T4 may further compromise cardiac output. Several authors have reported similar associations, emphasizing block height as one of the most consistent predictors of hypotension following spinal anaesthesia [18,19]. This underscores the importance of dose optimization and careful patient positioning to avoid excessively high sensory blocks.

Intrathecal Drug Dose

Although higher doses of intrathecal bupivacaine showed an increased incidence of hypotension on univariate analysis, this factor did not remain an independent predictor on multivariate analysis. This suggests that the effect of drug dose on hypotension may be mediated through its influence on block height rather than acting as an independent variable. Comparable observations have been reported in previous studies, where block height rather than absolute drug dose was more closely linked to hemodynamic instability [20].

Sex and Body Mass Index

In the present study, female sex and higher body mass index were not significantly associated with hypotension. While some studies have reported increased susceptibility among females due to physiological and hormonal factors, others have failed to demonstrate such an association [21,22]. Similarly, the role of body mass index in predicting hypotension remains controversial, with inconsistent findings across studies.

CONCLUSION:

Hypotension following spinal anaesthesia is a common perioperative complication in adult surgical patients. Advanced age, lower baseline systolic blood pressure, and higher sensory block level are significant independent predictors of its occurrence. Early identification of high-risk patients allows timely implementation of preventive and corrective measures. Tailoring spinal anaesthetic techniques and vigilant hemodynamic monitoring can reduce the incidence and severity of hypotension. These strategies may improve perioperative safety and overall patient outcomes in tertiary care settings.

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