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Association between patient age and hypotension following spinal anesthesia in general surgical patients

Nabila Alwan*, Dwi Novitasari, Danang Tri Yudono
Departement of Anesthesia, Faculty Health, Harapan Bangsa University Indonesia
*Corresponding author's email: nabilaalwan33@gmail.com

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Abstract

Background: Spinal anesthesia is widely used in lower-limb and abdominal surgeries; however, post-spinal anesthesia hypotension (PSAH) remains a frequent and clinically relevant complication. Patient age has been reported as a contributing factor, although findings across adult age groups remain inconsistent.
Objective: This study aimed to examine the association between patient age and the incidence of hypotension following spinal anesthesia in a secondary referral hospital in Indonesia.
Methods: A cross-sectional analytical study was conducted at Fatimah Islamic Hospital, Cilacap, from October to November 2024. A total of 42 adult patients undergoing surgery with spinal anesthesia were included using convenience sampling. Hypotension was defined as a reduction of ≥25% in systolic blood pressure from baseline or a systolic blood pressure ≤90 mmHg within 20 minutes after spinal anesthesia. Data were analyzed using the Chi-square test with a significance level of $p < 0.05$.
Results: Hypotension occurred in 30 of 42 patients (71.4%). The incidence of hypotension was highest in the 26–35-year age group (22/25; 88%), followed by the 36–45-year group (8/8; 100%), while no hypotension was observed in the 17–25-year group (0/9; 0%). Statistical analysis demonstrated a significant association between age group and the occurrence of hypotension following spinal anesthesia ($p < 0.001$).
Conclusion: Patient age was significantly associated with the occurrence of hypotension following spinal anesthesia, with higher incidence observed in adult age groups above 25 years.

Keywords: Spinal anesthesia; Hypotension; Age factors; Hemodynamic instability; Perioperative nursing.

INTRODUCTION

Spinal anesthesia is widely utilized for surgeries involving the lower abdomen, pelvis, and lower extremities due to its rapid onset, reliable sensory and motor blockade, and limited systemic drug exposure. Despite these advantages, it frequently results in post-spinal anesthesia hypotension (PSAH), which can lead to adverse outcomes such as dizziness, nausea, vomiting, reduced organ perfusion, and, in severe cases, cardiac or cerebral ischemia (1,2). Hemodynamic instability not only compromises intraoperative safety but also extends recovery time and hospital stay, especially in resource-limited settings (3,4).

The incidence of PSAH varies depending on patient population and setting, with reports ranging from 15% to 33% in general surgical patients (5,6), and reaching as high as 75% in obstetric cases such as cesarean sections (7). PSAH is primarily caused by sympathetic blockade, leading to vasodilation, decreased venous return, and reduced cardiac output (8). Multiple factors influence its occurrence, including fluid status, block height, and cardiovascular comorbidities. Among these, patient age has traditionally been considered a major contributor, with older adults thought to be at greater risk due to autonomic dysfunction and diminished baroreflex sensitivity (9,10).

However, recent studies have reported the occurrence of hypotension following spinal anesthesia among younger adult patients (11,12).These studies indicate that the association between age and post-spinal anesthesia hypotension is not consistently linear, with hypotension observed across different adult age groups, including early and mid-adulthood (13,14). Nevertheless, existing evidence remains limited, as many studies focus primarily on obstetric or elderly populations, while data on non-obstetric general adult surgical patients particularly in low-resource settings such as Indonesia are scarce (15–17).

While the pathophysiology of PSAH has been extensively described in the literature (18–21), there remains a lack of robust, population-specific research investigating age as a predictor of hypotension in general surgical patients. Most previous studies either focus on elderly or obstetric populations or do not stratify risk across adult age groups (1,15). This represents a significant gap in current knowledge, particularly in secondary referral hospitals in Indonesia where standardized prevention protocols may not yet reflect nuanced, age-based risk stratification (3).

This study therefore aims to examine the association between patient age and the occurrence of hypotension following spinal anesthesia in a secondary referral hospital in Indonesia. The findings are intended to provide evidence-based insight for nursing anesthesiology practice, particularly regarding age-informed monitoring and prevention strategies for hypotension.

METHOD

Study Design and Setting

This study applied a quantitative research method using a cross-sectional analytic design to evaluate the association between age and the occurrence of hypotension following spinal anesthesia (1,2). The research was conducted at the Central Surgical Installation of Fatimah Islamic Hospital, a secondary referral hospital located in Cilacap, Central Java, Indonesia. Data collection was carried out over a two-month period, from October to November 2024.

Participants and Sampling

The study population consisted of adult patients undergoing elective surgery under spinal anesthesia at Fatimah Islamic Hospital, Cilacap. A total of 42 patients were recruited using a convenience sampling method. This sampling approach was chosen due to practical considerations, including the limited study period, the availability of eligible patients during routine surgical schedules, and the feasibility of data collection within a secondary referral hospital setting.

Participants were included if they were aged 17–65 years, scheduled for elective surgery under spinal anesthesia, fully conscious, and willing to participate by providing written informed consent. Patients were excluded if they had a history of autonomic nervous system disorders, altered levels of consciousness, or declined participation.

The use of convenience sampling may limit the representativeness of the study sample and restrict the generalizability of the findings to broader surgical populations. Consequently, the results should be interpreted with caution and may primarily reflect the characteristics of patients treated in similar secondary referral hospital settings. Further studies employing probability-based sampling methods and larger, multicenter samples are recommended to enhance external validity.

Data Collection Procedure

Patient demographic data, including age, sex, and educational level, were obtained from hospital medical records. Perioperative data were collected using a structured observation sheet developed by the research team. Blood pressure was monitored using a bedside multiparameter monitor and recorded at 5-minute intervals for 20 minutes following the administration of spinal anesthesia (19).

Spinal anesthesia was administered using intrathecal local anesthetic agents according to standard clinical practice at the study site. However, detailed data regarding

the specific type of spinal anesthetic drugs and their exact dosages were not systematically recorded and therefore were not included in the analysis. In addition, the height of the sensory block was not formally assessed or documented during the data collection process and was not analyzed in this study(3,6).

Hypotension was operationally defined as a decrease in systolic blood pressure of ≥25% from baseline or a systolic blood pressure ≤90 mmHg within 20 minutes after spinal anesthesia administration. Baseline blood pressure was measured prior to the spinal block while the patient was in the supine position.

Statistical Analysis

All data were analyzed using IBM SPSS version 26.0. Descriptive statistics were used to summarize the sociodemographic characteristics and frequency of hypotension among participants. To evaluate the relationship between age group and the incidence of hypotension, a Chi-square test was applied, as commonly implemented in similar perioperative anesthesia studies [6,7]. The threshold for statistical significance was set at $p < 0.05$.

Ethical Considerations

Ethical approval was obtained from the Research Ethics Committee of Universitas Harapan Bangsa (No.B.LPPM-UHB/966/10/2024), and the study was conducted in accordance with the Declaration of Helsinki. Each participant received detailed information about the study and signed a written informed consent form prior to data collection. Participant confidentiality and anonymity were fully maintained throughout the research process.

RESULTS

This study involved a total of 42 adult patients undergoing elective surgery under spinal anesthesia. The majority of participants were female, accounting for 88.1% of the sample, while male patients comprised only 11.9%. In terms of age distribution, most patients fell into the 26–35-year age group (59.5%), followed by 17–25 years (21.4%) and 36–45 years (19.0%). The educational background of participants indicated that 61.9% had completed senior high school, while 33.3% held a bachelor's degree, and a small proportion (4.8%) had only completed junior high school (table 1)

Table 1. Demographic Characteristics of Study Participants (n = 42)

Variable	Category	Frequency (n)	Percentage (%)
Age Group	17–25 years	9	21.4
	26–35 years	25	59.5
	36–45 years	8	19.0
Gender	Male	5	11.9
	Female	37	88.1
Education Level	Junior High (SMP)	2	4.8
	Senior High (SMA)	26	61.9
	Bachelor's Degree	14	33.3

Post-spinal anesthesia hypotension occurred in 30 of the 42 patients, representing an overall incidence rate of 71.4%. The distribution of hypotension varied across age groups. In the 26–35-year age group, hypotension was observed in 22 of 25 patients (88%). In the 36–45-year age group, all eight patients (100%) experienced hypotension. In contrast, no cases of hypotension were observed among patients aged 17–25 years during the observation period (Table 2).

Table 2. Incidence of Hypotension by Age Group

Age Group	Hypotension (Yes)	Hypotension (No)	Total (n)	Hypotension Rate (%)
17–25 years	0	9	9	0.0
26–35 years	22	3	25	88.0
36–45 years	8	0	8	100.0
Total	30	12	42	71.4

Statistical analysis using the Chi-square test confirmed a strong and significant association between age and the occurrence of hypotension following spinal anesthesia. The p-value obtained was less than 0.001, indicating that the relationship between these variables is unlikely to be due to chance. These findings suggest that early and mid-adulthood may represent periods of heightened vulnerability to hemodynamic instability following spinal anesthesia, challenging conventional views that primarily associate this risk with older age.

DISCUSSION

This study is among the limited number of investigations conducted in an Indonesian perioperative setting that examine the association between patient age and the incidence of hypotension following spinal anesthesia among general surgical patients (1,2).The analysis identified a statistically significant association between age group and the occurrence of hypotension following spinal anesthesia. The highest incidence was observed in patients aged 26–35 years (88%), while no cases were observed in the 17–25-year age group [3,4].

While previous literature often identifies aging as a primary risk factor due to autonomic dysfunction and reduced baroreflex sensitivity (5,6), our findings suggest that younger adults may also be at increased risk, albeit through different physiological mechanisms (7,8). In younger individuals, especially those in early adulthood, baseline sympathetic tone tends to be higher, potentially leading to a more dramatic decrease in systemic vascular resistance when sympathetic blockade occurs during spinal anesthesia (9,10). Additionally, vascular compliance is greater in younger patients, which may contribute to rapid peripheral pooling and reduced venous return upon administration of a spinal block (12). These mechanisms could explain the unexpectedly high rate of hypotension in early adulthood, as also reported in regional and international studies that observed similar age-related hemodynamic trends among spinal anesthesia patients (11,14).

Conversely, no incidence of hypotension was observed in the 17–25-year age group, which may reflect greater cardiovascular resilience in late adolescence (13). Younger patients may have more effective compensatory mechanisms such as faster baroreceptor reflexes and better heart rate adaptability to counteract the vasodilatory effects of spinal anesthesia (15,16). Psychological and lifestyle factors could also play a role; younger adults in the 26–35 age group may face increased stress, unrecognized hypertension, or subclinical autonomic imbalance due to occupational or metabolic pressures (17).

Our findings partially contrast with those of de Boer et al., who identified older age as a predictor of hypotension in cesarean section patients under spinal anesthesia (20). However, the discrepancy may stem from population differences, as obstetric patients often have different hemodynamic baselines compared to general surgical patients (19). It is increasingly clear that age alone is not a sufficient predictor of hypotension risk; instead, a broader understanding of physiological variability across age groups is essential (1,2).

These results hold meaningful implications for anesthetic nursing practice. Clinical protocols often prioritize hypotension prevention in geriatric populations, while overlooking younger adults who may also require hemodynamic optimization (15). Strategies such as adequate preloading, slow anesthetic administration, and early vasopressor readiness should be considered for all adult patients, regardless of age (5). Nursing anesthesiologists should be especially attentive during the first 20 minutes post-spinal injection, a critical window when blood pressure tends to drop rapidly (3).

Despite its contributions, this study has several limitations. The single-center design and relatively small sample size (n = 42) limit the generalizability of the findings. Moreover, important variables such as body mass index

(BMI), anesthetic drug dose, block level, and preoperative anxiety were not included in the analysis. These factors may confound the relationship between age and hypotension. In addition, the use of only bivariate analysis (Chi-square test) without multivariable adjustments restricts the ability to assess age as an independent predictor. Future studies should use larger, multicenter designs and incorporate multivariate regression modeling to validate and refine these findings (2,5,19).

CONCLUSIONS

This study examined the association between patient age and the occurrence of hypotension following spinal anesthesia among general surgical patients in a secondary referral hospital. A statistically significant association between age group and post-spinal anesthesia hypotension was identified, with higher incidence observed in patients aged 26–35 years. These findings highlight the importance of considering age as a factor in perioperative blood pressure monitoring and support the need for further research using larger, multicenter samples.

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