

THE RELATIONSHIP OF BLOOD PRESSURE CHANGES TO THE INCIDENCE OF IONV IN HYPERTENSIVE PATIENTS WHO UNDERWENT REGIONAL ANESTHESIA

Andini Tiara Pertiwi^{1*}, Suryanto², Merisdawati MR³, Reko Priyonggo⁴

Bachelor of Applied Science in Anesthesia Nursing, ITSK Hospital. dr. Soepraoen,
Malang, Indonesia

andinitiarapertiwi@gmail.com^{1}, suryanto@itsk-soepraoen.ac.id², merisdawati@itsk-
soepraoen.ac.id³, rekopriyonggo@itsk-soepraoen.ac.id⁴*

**Corresponding author*

Received July 31, 2026; Revised Sept 21, 2026; Accepted Sept 23, 2026; Published Sept 24, 2026

ABSTRACT

Spinal anesthesia produces sympathetic blockade, which can cause vasodilation and intraoperative hypotension (IOH), one of the most common hemodynamic complications. Intraoperative hypotension may be defined using absolute thresholds, such as mean arterial pressure (MAP) <65–70 mmHg, or relative thresholds, such as a decrease of >20% from baseline. Hemodynamic changes during spinal anesthesia may contribute to intraoperative nausea and vomiting (IONV). This study aimed to determine the relationship between intraoperative blood pressure changes and the incidence of intraoperative nausea and vomiting (IONV) in hypertensive patients undergoing spinal anesthesia. This study used an analytical observational design with a cross-sectional approach. A total of 59 hypertensive patients undergoing surgery under spinal anesthesia were recruited using consecutive sampling. The independent variable was intraoperative blood pressure change, while the dependent variable was IONV. The relationship between the variables was analyzed using Spearman's rho correlation test. There was a statistically significant correlation between intraoperative blood pressure changes and IONV (Spearman's $\rho = -0.538$, $p < 0.001$). A statistically significant correlation was found between intraoperative blood pressure changes and IONV among hypertensive patients undergoing spinal anesthesia. These findings highlight the importance of careful intraoperative hemodynamic monitoring in this population.

Keywords: *Regional anesthesia, spinal anesthesia, IONV, intraoperative blood pressure changes, intraoperative hypotension.*

INTRODUCTION

Surgery is a crucial medical intervention to address pathological conditions, where the success of which depends heavily on the role of anesthesia in ensuring patient safety and comfort. Currently, there is an increasing trend in the use of regional anesthesia over general anesthesia due to its ability to reduce postoperative complications, speed recovery, and lower the need for opioids (Ruppen et al., 2025). Although it offers many advantages, regional techniques such as spinal anesthesia have a physiological effect in the form of a sympathetic blockade that triggers vasodilation. This often leads to intraoperative hypotension (HIO) as the most common hemodynamic complication (Shams et al., 2024).

Intraoperative hypotension was defined in absolute terms (MAP < 65–70 mmHg) and relative (>20% decrease from baseline). This phenomenon is closely related to an

increased risk of serious morbidity, such as acute kidney injury, myocardial infarction, and death (Kouz et al., 2020). The incidence of HIO is reported to be very high, reaching 60–90% in certain populations (Weinberg et al., 2022). In addition to systemic impacts, HIO is recognized as a major trigger of intraoperative nausea and vomiting (IONV). The mechanism involves transient cerebral hypoperfusion that activates Chemoreceptor Trigger Zone (CTZ) in the medulla, as well as a decrease in visceral perfusion that triggers the release of serotonin in the gastrointestinal tract (Arsani et al., 2022)

IONV is a significant problem that increases patient discomfort and the risk of serious complications such as gastric aspiration. In cesarean section procedures under regional anesthesia, the prevalence of IONV ranges from 24–36% (Puri et al., 2023). This is a complication that is quite often found in regional anesthesia, with a varying prevalence and can reach around 36%, and can cause significant discomfort and interfere with the operation (Demilew et al., 2025).

Previous studies have reported an association between intraoperative hypotension and nausea and vomiting; however, these studies were conducted in different surgical and anesthetic populations and did not specifically focus on hypertensive patients undergoing spinal anesthesia. Recent studies have demonstrated an association between intraoperative hypotension and nausea and vomiting in surgical populations (Goss et al., 2024; Nakatani et al., 2023), while recent evidence on regional anesthesia has largely focused on specific populations, particularly patients undergoing cesarean section (Demilew et al., 2025). Therefore, the novelty of the present study lies in its specific focus on the relationship between intraoperative blood pressure changes and IONV among hypertensive patients undergoing regional anesthesia with a spinal anesthesia technique. This specific population and anesthetic setting distinguish the present study from previous research and may provide more clinically relevant evidence regarding intraoperative hemodynamic changes and IONV in hypertensive patients.

The purpose of this study was to test and analyze whether there is a significant relationship between intraoperative blood pressure changes (fluctuations) and the incidence of intraoperative nausea and vomiting (IONV) in hypertensive patients who were subjected to regional anesthesia.

RESEARCH METHOD

This study used a quantitative analytical observational design with a cross-sectional approach. The researchers did not provide any intervention or treatment but observed variables occurring during the perioperative period. The study was conducted at Ngudi Waluyo Wlingi Blitar Hospital from April to May 2026. The study population consisted of patients with hypertension undergoing surgery under spinal anesthesia. A total of 59 respondents were recruited using consecutive sampling. The inclusion criteria were adult patients aged >18 years with pre-hypertension, stage 1 hypertension, or stage 2 hypertension; undergoing surgery under spinal anesthesia; and classified as ASA physical status II–III. The independent variable was intraoperative blood pressure change, while the dependent variable was the incidence/severity of intraoperative nausea and vomiting

(IONV). The relationship between blood pressure changes and IONV was analyzed using Spearman's rho correlation test with SPSS version 27.

RESULTS AND DISCUSSION

Characteristics of Respondents at Ngudi Waluyo Wlingi Hospital

This sub-chapter presents the general characteristics of respondents including gender, age, incidence of IONV and the stage of hypertension suffered.

Table 1. Description of respondent characteristics by gender, age category and stage of hypertension

Features	f	Presentase %
Gender		
Male	30	50.8
Women	29	49.2
Category: Usia		
18 – 25 years old	3	5.1
26 – 45 years old	19	32.2
46 – 59 years old	10	16.9
≥ 60 years old	27	45.8
Stadium Hipertensi		
Pre-Hypertension	24	40.7
Hipertensi stadium 1	21	35.6
Hipertensi stadium 2	14	23.7
Total	59	100

Results in table 1. The distribution of respondents based on gender was majority, namely 30 respondents (50.8%) for men while 29 respondents (49.2%) for women. Based on age categories, respondents aged 18-25 years were 3 (5.1%), respondents aged 26-45 years were 19 (32.2%), respondents aged 46-59 years were 10 (16.9%), and respondents over the age ≥ 60 years were only 27 (45.8%) respondents. Based on the stage of hypertension, the most affected stages were pre-hypertension as many as 24 (40.7%) respondents, stage 1 hypertension as many as 21 (35.6%) respondents, and respondents with stage 2 hypertension as many as 14 (23.7%).

Cross-tabulation between the stages of hypertension per respondent with the incidence of IONV

This sub-chapter presents a cross-tabulation table containing the stages of hypertension suffered by each respondent with the incidence of nausea and vomiting during intraoperatives.

Table 2. Cross-tabulation between the stages of hypertension and the incidence of IONV

		IONV				Total
		No nausea	Nausea	Tossing without the stomach contents	Vomiting with stomach contents	
HT stage	Pre Hypertension	14	6	3	0	23
	Hypertension I	20	1	1	0	22
	Hypertension II	11	2	1	0	14
Total		45	9	5	0	59

As shown in Table 2, the cross-tabulation data, out of a total of 23 respondents in the pre-hypertension category, the majority did not experience nausea as many as 14 respondents, but it was found that 6 respondents experienced nausea and 3 respondents experienced vomiting without stomach contents. In the stage I hypertension group of a total of 22 respondents, as many as 20 respondents did not experience nausea, 1 person experienced nausea and 1 person vomited without stomach contents. Meanwhile, in the stage II hypertension group with a total of 14 respondents, there were 11 respondents who were not nauseous, 2 respondents experienced nausea, and 1 respondent experienced vomiting without stomach contents. Overall, out of a total of 59 respondents, none of the respondents, both from pre-hypertension, stage I and II hypertension, experienced clinical symptoms in the form of vomiting by expelling gastric contents. This data shows that IONV complaints in the form of nausea to vomiting are found to spread across all stages of hypertension with varying degrees.

Relationship of Blood Pressure Changes to IONV Incidence

Table 3. The Relationship between Changes in Blood Pressure and the Incidence of Nausea and Vomiting in Hypertensive Patients Who Underwent Regional Anesthesia

			TD Changes	IONV
Spearman's rho	TD Changes	Correlation Coefficient	1000	-0.538
		Sig. (2-tailed)		<0.001
		N	59	59
	IONV	Correlation Coefficient	-0.538	1000
		Sig. (2-tailed)	<0.001	
		N	59	59

As shown in Table 3, Spearman's rho analysis showed a statistically significant correlation between intraoperative blood pressure changes and IONV ($\rho = -0.538$, $p < 0.001$; $n = 59$). The correlation coefficient indicates a moderately strong negative correlation between the two variables. Therefore, the null hypothesis (H_0) was rejected. The direction of the correlation should be interpreted according to the coding used for blood pressure changes and IONV severity.

In addition, based on the cross-tabulation between hypertension stages and IONV, complaints of nausea and retching were observed across the pre-hypertension, stage I hypertension, and stage II hypertension groups. Notably, none of the respondents experienced vomiting with gastric contents.

The findings of the present study are consistent with previous evidence indicating an association between intraoperative blood pressure changes and nausea and vomiting. Previous studies have demonstrated that intraoperative hypotension is associated with an increased occurrence of nausea and vomiting, supporting the relevance of maintaining hemodynamic stability during anesthesia. However, nausea and vomiting are multifactorial outcomes and cannot be attributed solely to changes in blood pressure. Recent evidence indicates that patient-related, anesthetic, and surgical factors may also contribute to the occurrence of nausea and vomiting. A systematic review and meta-analysis of patients undergoing cesarean section under regional anesthesia identified several factors associated with IONV, including a history of motion sickness, preeclampsia, uterine exteriorization, and intraoperative medication-related factors (Demilew et al., 2025). Similarly, recent evidence has identified factors such as a history of motion sickness and a decrease in systolic blood pressure of more than 20% as independent predictors of nausea and vomiting (Liu et al., 2025). Therefore, the significant correlation observed in the present study should be interpreted within the multifactorial nature of IONV rather than considering intraoperative blood pressure changes as its sole determinant.

Physiologically, the close relationship between changes in blood pressure and the occurrence of IONV is triggered by the blockade mechanism of the sympathetic nervous system due to the regional (spinal) action of anesthesia. This sympathetic blockade triggers massive peripheral vascular vasodilation and blood buildup (*pooling*) in the lower extremities, which clinically manifests as a sudden decrease in cardiac volume and arterial blood pressure. This systemic hypotension condition results in hypoperfusion of vital organs, including the brain and digestive tract. The reduction in arterial blood pressure following spinal anesthesia may reduce cerebral and gastrointestinal perfusion, which has been proposed as one of the mechanisms contributing to nausea and vomiting during spinal anesthesia. In patients with a history of hypertension (from pre-hypertension to advanced stages), the autoregulatory curve of brain blood flow has shifted to the right. Therefore, altered autoregulatory responses in patients with hypertension may increase their susceptibility to reductions in organ perfusion when blood pressure decreases during spinal anesthesia. However, the present study did not directly assess cerebral perfusion or autoregulatory function.

The age distribution of the respondents may also be relevant when interpreting the findings, as 45.8% of the participants were aged ≥ 60 years. Referring to the latest clinical studies on geriatric hemodynamics (Staheli & Rondeau, 2023), elderly patients naturally experience a decrease in blood vessel elasticity (vascular stiffness) as well as a decrease in sensitivity of the baroreceptor reflex to compensate for changes in blood pressure. Age-related changes in vascular compliance and baroreflex function may influence

hemodynamic responses to spinal anesthesia. Nevertheless, the present study did not specifically analyze age as an independent factor associated with IONV. Notably, none of the respondents experienced vomiting with gastric contents. However, the present study was not designed to determine the factors responsible for the absence of this outcome. Therefore, this finding should be interpreted descriptively and should not be attributed to specific perioperative factors that were not evaluated in the present study.

The present findings extend previous evidence by demonstrating a significant correlation between intraoperative blood pressure changes and IONV specifically among hypertensive patients undergoing spinal anesthesia (Spearman's $\rho = -0.538$, $p < 0.001$). Previous studies have reported related associations, but in different populations and anesthetic settings. Nakatani et al. (2023) reported an association between intraoperative hypotension and postoperative nausea and vomiting in patients undergoing thyroidectomy under general anesthesia, whereas recent evidence concerning regional anesthesia has predominantly focused on obstetric populations undergoing cesarean section (Demilew et al., 2025). In addition, Goss et al. (2024) demonstrated an association between intraoperative hypotension and postoperative nausea and vomiting in a broader surgical population. In contrast to these previous studies, the present study specifically examined intraoperative blood pressure changes in relation to IONV among hypertensive patients undergoing spinal anesthesia. Therefore, the novelty of the present study lies in its specific population and anesthetic setting, providing evidence that intraoperative blood pressure changes are significantly associated with IONV in hypertensive patients undergoing spinal anesthesia. Nevertheless, given the cross-sectional design, this finding represents an association rather than a causal relationship.

These findings highlight the clinical importance of careful hemodynamic monitoring in hypertensive patients undergoing spinal anesthesia. Maintaining appropriate blood pressure during the intraoperative period is important for preserving organ perfusion and may also reduce conditions associated with nausea and vomiting (Halim et al., 2026; Woodford et al., 2025). Further prospective studies with adjustment for potential confounding factors are needed to clarify the independent relationship between blood pressure changes and IONV in hypertensive patients.

CONCLUSION

This study found a statistically significant correlation between intraoperative blood pressure changes and IONV among hypertensive patients undergoing spinal anesthesia at Ngudi Waluyo Wlingi Blitar Hospital (Spearman's $\rho = -0.538$, $p < 0.001$). These findings indicate that intraoperative blood pressure changes are associated with IONV in this population. Careful intraoperative hemodynamic monitoring is therefore important in hypertensive patients undergoing spinal anesthesia. Further studies are needed to determine the independent contribution of blood pressure changes to IONV after accounting for other potential risk factors.

REFERENCES

- Adiputra, I. M. S., Trisnadewi, N. W., Oktaviani, N. P. W., Munthe, S. A., Hulu, V. T., Budiastutik, I., Faridi, A., Ramdany, R., Fitriani, R. J., Tania, P. O. A., Rahmiati, B. F., Lusiana, S. A., Susilawaty, A., Sianturi, E., & Suryana. (2021). *Metodologi penelitian kesehatan*. Yayasan Kita Menulis.
- Arsani, F., Cipta, C. R., & Purwaningsih, H. (2022). Hubungan hipotensi dengan kejadian post operative nausea and vomiting (PONV) pada pasien pasca spinal anestesi. *Jurnal Ilmiah Kedokteran dan Kesehatan*, 1(3), 179–188. <https://doi.org/10.55606/klinik.v1i3.2182>
- Demilew, B. C., Zurbachew, N., Getachew, N., Mekete, G., & Teshome, D. (2025). Prevalence and associated factors of intraoperative nausea and vomiting of mothers who gave birth with cesarean section under regional anesthesia: A systematic review and meta-analysis; 2023. *BMC Pregnancy and Childbirth*, 25(1), 1-15. <https://doi.org/10.1186/s12884-025-07363-z>
- Goss, S., Jedlicka, J., Strinitz, E., Niedermayer, S., Chappell, D., Hofmann-Kiefer, K., Hinske, L. C., & Groene, P. (2024). Association between intraoperative hypotension and postoperative nausea and vomiting: A retrospective cohort study. *Current Medical Research and Opinion*, 40(8), 1439–1448. <https://doi.org/10.1080/03007995.2024.2373885>
- Halim, N. A., Masdar, A., Sayed Masri, S. N. N., Khalid, I., Budiman, M., & Cheah, S. (2026). The effect of using Hypotension Prediction Index to reduce intraoperative hypotension in elective cesarean sections: A randomized controlled trial. *Medicina*, 62(8), 1-16. <https://doi.org/10.3390/medicina62081486>
- Kouz, K., Hoppe, P., Briesenick, L., & Saugel, B. (2020). Intraoperative hypotension: Pathophysiology, clinical relevance, and therapeutic approaches. *Indian Journal of Anaesthesia*, 64(2), 90–96. https://doi.org/10.4103/ija.IJA_939_19
- Liu, Y.-C., Zhong, H.-H., Dai, Z., Huang, Y., Liu, Y.-B., He, H., Liao, Y.-Q., & Liu, W. (2025). Predicting postoperative nausea and vomiting after cesarean section: A nomogram model combined with gastric ultrasound. *BMC Anesthesiology*, 25(64), 1-11. <https://doi.org/10.1186/s12871-025-02936-z>
- Nakatani, H., Naito, Y., Ida, M., Sato, M., Okamoto, N., Nishiwada, T., & Kawaguchi, M. (2023). Association between intraoperative hypotension and postoperative nausea and vomiting: A retrospective analysis of 247 thyroidectomy cases. *Brazilian Journal of Anesthesiology*, 73(5), 635–640. <https://doi.org/10.1016/j.bjane.2021.02.029>
- Puri, R., Situ, S., Minhas, H. S., Rastogi, B., Solanki, A., & Niharika. (2023). Is low dose ketamine effective as antiemetic prophylaxis for intraoperative nausea and vomiting during caesarean section under spinal anaesthesia: A prospective randomized study. *Global Journal for Research Analysis*, 12(2), 4–7. <https://doi.org/10.36106/gjra/0903313>
- Ruppen, I. C., Ricardo de Oliveira, R., Morsoletto, J. M. Q., Vasconcellos, V. R. B., Sordi, M., Watanabe, K. K., Moraes da Costa Júnior, L. F., Durante, V. R. F., Gurgel, R. V. T., Biscaia, J. V. F., Zanini, C. A., Consalter de Mello, M. R., Gaeski de Chaves, J. R., & Bitiati, L. B. D. (2025). Plastic surgery and anesthesia

management, risks and complication control: A brief review. *Journal of Medical Research and Surgery*, 6(3), 57–59. <https://doi.org/10.52916/jmrs254171>

Shams, D., Sachse, K., Statzer, N., & Gupta, R. K. (2024). Regional anesthesia complications and contraindications. *Anesthesiology Clinics*, 42(2), 329–344. <https://doi.org/10.1016/j.anclin.2023.11.013>

Staheli, B., & Rondeau, B. (2023). Anesthetic considerations in the geriatric population. In *StatPearls [Internet]*. StatPearls Publishing.

Weinberg, L., Li, S. Y., Louis, M., Karp, J., Poci, N., Carp, B. S., Miles, L. F., Tully, P., Hahn, R., Karalapillai, D., & Lee, D.-K. (2022). Reported definitions of intraoperative hypotension in adults undergoing non-cardiac surgery under general anaesthesia: A review. *BMC Anesthesiology*, 22(69), 1-12. <https://doi.org/10.1186/s12871-022-01605-9>

Woodford, S. F., Rinehart, J. B., Peyton, P. J., & Riedel, B. (2025). Clarity in hemodynamics and end-organ perfusion: Pulsatility, patient phenotype, and the pressure field as a novel approach. *Anesthesia & Analgesia*, 141(1), 113–119. <https://doi.org/10.1213/ANE.00000000000007465>