ORIGINAL ARTICLE

Post-Induction Hypotension among Elderly Patients With and Without Underlying Metabolic Diseases and End Organ Damage Underwent General Anesthesia: A Retrospective Cohort Study

Santi Anchalee, MD[1], Wit Wichaidit, PhD[2], Perinpit Jitmun, BNS[1], Siriraksa Pooriyapan, BNS[1], Sopida Kampeng, BNS[1], Sumidtra Prathep, MD[1]

[1] Department of Anesthesiology, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkla, Thailand; [2] Department of Epidemiology, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkla, Thailand

Objective: To compare the incidence of post-induction hypotension and the use of vasopressor drugs during induction among elderly patients who underwent general anesthesia, with and without underlying metabolic diseases and end-organ damage.

Materials and Methods: A retrospective study was conducted on 1,390 elderly patients aged 65 years or older who underwent general anesthesia at Songklanagarind Hospital. The subjects were classified into three groups, Group R, elderly patients with no diabetes mellitus (DM), dyslipidemia (DLP), and hypertension (HTN), Group M, elderly patients with DM, HT, or DLP without end-organ damage, and Group E, elderly patients with DM, HT, or DLP with end-organ damage. Baseline characteristics were recorded according to patient factors, anesthetic factors, and surgical factors. The outcome was post-induction hypotension, defined as systolic blood pressure of less than 90 mmHg during the first 20 minutes after anesthesia induction. The information collected from the anesthetic records within the electronic hospital information system.

Results: Among the present study patients, 22.7% were in Group R, 49.5% were in Group M, and 27.8% were in Group E. The incidence of post-induction hypotension in Groups R, M, and E was 27.9%, 28.3%, and 35.1%, respectively with R versus M at adjusted OR 1.05, 95% CI 0.78 to 1.43, and R versus E at adjusted OR 1.49, 95% CI 1.06 to 2.08. The incidence of vasopressor drug usage during induction in Groups R, M, and E was 27.6%, 29.5%, and 38.0%, respectively with R versus M at adjusted OR 1.10, 95% CI 0.82 to 1.49 and R versus E at adjusted OR 1.58, 95% CI 1.14 to 2.21.

Conclusion: The incidences of post-induction hypotension and the use of vasopressor drugs during induction were higher in elderly patients with metabolic diseases and end-organ damage compared to those without metabolic diseases.

Keywords: Elderly; Post-induction hypotension; General anesthesia; Diabetes mellitus; Dyslipidemia; Hypertension; End organ damage

Received 16 January 2025 | Revised 3 June 2025 | Accepted 11 June 2025

J Med Assoc Thai 2025;108(7):512-9

Website: http://www.jmatonline.com

The global elderly population is rapidly increasing, which has important implications for perioperative management. Aging is associated with physiological changes that impact cardiovascular homeostasis, including decreased arterial compliance, impaired baroreflex sensitivity, and reduced autonomic regulation[1]. These age-related alterations contribute to an increased susceptibility to hemodynamic instability, including post-induction and intraoperative hypotension (IOH).

The elderly population tends to have comorbidities, especially metabolic diseases such as diabetes mellitus (DM), dyslipidemia, and hypertension. Each condition can uniquely contribute to the risk of post-induction hypotension (PIH). For instance, diabetes may have cardiac autonomic neuropathy[2], hypertension can lead to increased vascular stiffness[3], and dyslipidemia may contribute to atherosclerotic changes[4], all of which affect blood pressure regulation during anesthesia. The prevalence of dyslipidemia in elderly patients was 56.8% to 70.64%[5-7]. The incidence of DM was 18.03% in Indian patients aged 65 to 74 years[8]. In the United States, the incidence of hypertension among individuals aged 60 to 79 years was 52.3% in males and 48.8% in females[9]. While regional

Correspondence to:

Prathep S.
Department of Anesthesiology, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.
Phone: +66-88-7523423
Email: prathepsumidtra@gmail.com

How to cite this article:

Anchalee S, Wichaidit W, Jitmun P, Pooriyapan S, Kampeng S, Prathep S. Post-Induction Hypotension among Elderly Patients With and Without Underlying Metabolic Diseases and End Organ Damage Underwent General Anesthesia: A Retrospective Cohort Study. J Med Assoc Thai 2025; 108:512-9.

DOI: 10.35755/jmedassocthai.2025.7.512-519-01784

studies provide insight into disease burden, more comprehensive global data can better contextualize the relevance of these conditions in the aging population.

Various definitions of PIH and IOH have been reported[10-16]. PIH typically refers to hypotension occurring within the first 20 minutes following induction of anesthesia[10], and the present study adopted this definition, using a threshold of systolic blood pressure (SBP) of less than 90 mmHg. The IOH definitions differ in terms of duration, thresholds, and relative versus absolute blood pressure drops.

The incidence of IOH varies between 9.01% and 64.8%[13-16], depending on the definition of hypotension used in numerous studies. Hypotension can be classified into two types, relative hypotension and absolute hypotension. Relative hypotension is defined by a comparison to baseline blood pressure, such as a decrease in mean arterial pressure (MAP) by 30% from the baseline. Absolute hypotension is defined by specific cutoff values, such as a SBP of less than 90 mmHg or a MAP of less than 65 mmHg. Complications related to PIH/IOH are rare with 0.09% to 7.4%. Reported complications were ischemic stroke, acute coronary syndrome, and acute kidney injury[10-12].

The three factors related to IOH are patient factors, anesthetic factor, and surgical factor. The patient factors were elderly patient, American Society of Anesthesiologists (ASA) physical status, receiving preoperative diuretic drug, preoperative blood pressure both high and low, underlying diseases as DM, renal failure, and preoperative anemia[13-16]. The anesthetic factors were propofol and dosage of fentanyl[13]. The surgical factor was emergency surgery[15]. Emergency procedures often limit preoperative optimization, involve more rapid anesthetic induction, and are associated with greater physiological stress, all contributing to increased risk of hemodynamic instability.

Although studies have investigated PIH in elderly patients, few have directly addressed elderly individuals with metabolic diseases and end-organ damage. Moreover, limited research exists comparing this population to elderly patients without such comorbidities. To address this gap, the present study aimed to evaluate the incidence of PIH and the use of vasopressor agents during anesthetic induction in elderly patients with and without underlying metabolic diseases and end-organ damage.

Materials and Methods

Study design and setting

The present study was a retrospective observational study conducted at Songklanagarind Hospital, Thailand, between January and October 2023.

Study participants and study criteria

The present study participants included elderly patients who underwent general anesthesia. The inclusion criteria were individuals aged 65 years and older who underwent balanced general anesthesia with the endotracheal tube. The exclusion criteria included patients who had been intubated before the operation, those who received sedative drugs during the performance of peripheral nerve blocks or epidural block before the induction of general anesthesia, those with end organ damage without metabolic disease, those who underwent general anesthesia using the total intravenous anesthesia (TIVA) technique, and those who remained intubation after the operation.

Exposure measurement: metabolic disease and end organ damage

After receiving data on underlying metabolic diseases and underlying diseases, the patients were classified into three groups, Group R (reference), with patients with no history of DM, HT, or DLP, Group M (metabolic), with patients with DM, HT, DLP, or combined, and Group E (end organ damage), consisting of elderly patients with DM, HT, DLP, or combined with end-organ damage.

Outcome measurement

The authors defined PIH as SBP of less than 90 mmHg during the first 20 minutes after induction of anesthesia, with SBP recorded every five minutes during this period. Hypertension during emergence or extubation was defined as SBP of equal to or greater than 180 mmHg after the administration of the reversal drug of neuromuscular blocking drugs (NMBDs) until extubation.

Measurement of demographic data and clinical characteristics and surgical information

Demographic data included gender, age, body weight, height, body mass index (BMI), hematocrit, and ASA physical status. Underlying metabolic diseases such as DM, HTN, or DLP were recorded. Moreover, if the patient had end organ damage, data were recorded regarding which organs were affected, such as coronary artery disease, cerebrovascular disease, peripheral vascular disease, end-stage renal disease, retinopathy, and neuropathy. The surgical information included the type of operation, whether elective or emergency surgery, and the sites of operation. The anesthetic information encompassed the anesthetic drug and dosage, the type of volatile anesthetic, and the anesthetic technique.

Data collection

The data of all patients underwent general anesthesia was retrieved from the anesthesiology department database saved in Microsoft Excel. Patients aged 65 years or older were screened from this dataset. After obtaining this data, information was collected from the anesthetic records stored in the electronic hospital information system (HIS). The anesthetic record form consists of four parts, preoperative, intraoperative, recovery room, and postoperative sections. Data collection focused on the preoperative and intraoperative sections of the anesthetic record form.

Sample size calculation

The sample size was calculated for comparing two population proportions. A pilot study of 100 subjects was conducted to detect the proportion in each group. The subjects were classified into three groups, Group R, Group M, and Group E. A total of 1,373 patients were calculated as adequate to detect differences with 80.0% power and a two-tailed α error of 5.0%.

Based on data from a pilot study of 100 subjects, 26 were classified into Group R, of whom two experienced PIH, resulting in an incidence of 7.69%. Group M included 51 subjects, with 14 experienced PIH (27.45%), while Group E comprised 23 subjects, with eight cases of PIH (34.78%). Using these pilot data, the calculated sample sizes for pairwise comparisons were as follows, Group R versus Group M required 67 subjects per group, Group R versus Group E required 42 subjects per group, and Group M versus Group E required 653 subjects per group. Therefore, the total calculated sample size was 67+653+653 = 1,373 subjects.

Statistical and data analysis

Continuous data were expressed as median and interquartile range (IQR), or mean with standard deviation (SD), while categorical data were presented as frequency (percentage). Differences between Group R, Group M, and Group E were evaluated using Pearson's chi-squared test, Kruskal-Wallis test, and ANOVA F-test. Differences between PIH versus post-induction normotension, use of vasopressor drugs during induction, non-use, normotension during extubation versus hypertension during extubation, and use of antihypertensive drugs during extubation versus non-use were evaluated using Pearson's chi-squared test. Odds ratios (ORs) and adjusted ORs with 95% confidence intervals (CIs) for each previously mentioned outcome were evaluated using univariable and multivariable logistic regression. Data management and analysis were performed using R software, version 4.3.3. Statistical significance was assumed if the p-value was less than 0.05. Potential confounding variables, such as baseline blood pressure, type of induction agents, and comorbidity status, were adjusted for in the multivariable logistic regression analysis. However, residual confounding cannot be ruled out due to unmeasured factors.

Ethical approval

The present study received approval from the Institutional Ethical Review Board (Prince of Songkla University, Thailand, REC.66-502-8-1). Informed consent was waived.

Results

One thousand three hundred ninety subjects were analyzed and included 693 males and 697 females (Figure 1). In the present study, patients classified as Group R accounted for 315 (22.7%), Group M 688 (49.5%), and Group E 387 (27.8%). The age of Group E was the highest at 74 (IQR 70, 80) compared to the other groups, with Group R at 70 (IQR 67, 74) and Group M at 72 (IQR 68, 77) ($p<0.001$). Male gender was highest in Group E, at 63.31%, compared to 48.89% in Group R and 43.31% in Group M, with statistical significance. Gender differences may influence the hemodynamic response to anesthesia due to variations in hormonal regulation, vascular tone, and autonomic reactivity, which may contribute to differences in hypotension risk. The baseline characteristics of the patients were summarized in Table 1. These variables, such as age, gender, baseline blood pressure, and ASA status, were crucial because they influence hemodynamic responses during anesthesia, and their associations with PIH were examined through multivariable logistic regression.

The incidences of PIH were 27.9%, 28.3%, and 35.1% in Group R, M, and E, respectively ($p=0.04$). Compared to Group R, the adjusted OR for PIH

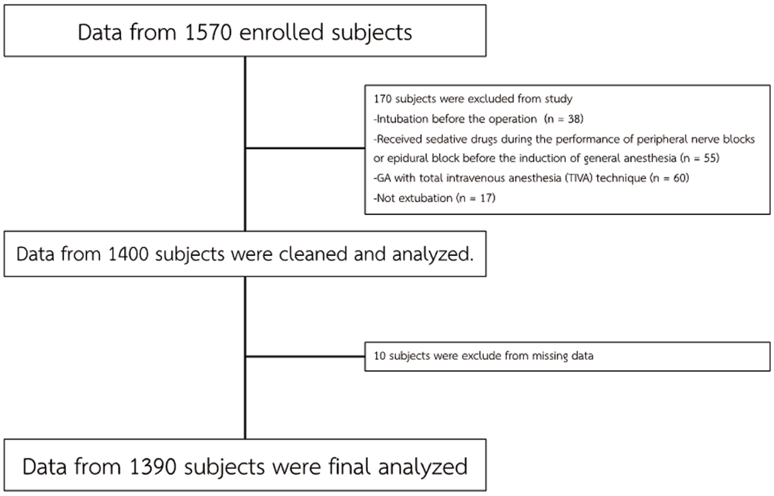

Figure 1. Flow chart of patient enrollment.

GA: general anesthesia

was 1.05 (95% CI 0.78 to 1.43) for Group M and 1.49 (95% CI 1.06 to 2.08) for Group E (Table 2). The results were analyzed via multivariate logistic regression with adjusted Group M, Group E, gender, age, use of propofol, use of etomidate, and baseline SBP.

The incidence of vasopressor drug used during induction was 27.6%, 29.5%, and 38% (p=0.0041) respectively. The adjusted OR for vasopressor drug used during induction was 1.1 (95% CI 0.82 to 1.49) for Group M compared to Group R, and 1.58 (95% CI 1.14 to 2.21) for Group E compared to Group R. The results were analyzed via multivariate logistic regression with adjusted same as analysis of PIH. All relevant outcomes were consistently reported with adjusted ORs and 95% CIs to enhance interpretability.

The incidence of hypertension during emergence or extubation was highest in Group E, at 20.7%, compared to 7.9% in Group R and 14.8% in Group M (p<0.001). This may reflect the heightened cardiovascular reactivity and stress response in patients with comorbidities, which has important clinical implications in planning extubation strategies and managing postoperative hemodynamics. The adjusted OR for hypertension during extubation was 1.93 (95% CI 1.23 to 3.12) for Group M compared to Group R, and 2.92 (95% CI 1.82 to 4.84) for Group E compared to Group R (Table 3). The data were analyzed via multivariate logistic regression with adjusted Group M, Group E, gender, age.

Additionally, the incidence of antihypertensive drug use during extubation was 7.00%, 11.9%, and 21.4% (p<0.001). The adjusted OR for antihypertensive drug use during extubation was 1.71 (95% CI 1.06 to 2.86) for Group M compared to Group R and 3.27 (95% CI 2.00 to 5.54) for Group E compared to Group R. The data was analyzed via multivariate logistic regression with adjusted Group M, Group E, gender, age.

Discussion

The present research is applicable to the care of elderly patients undergoing general anesthesia. Moreover, anesthesiologists working with elderly patients can apply these findings to various aspects of patient management, such as hemodynamic management, anesthetic considerations for the elderly, and overall anesthetic planning.

The incidence of PIH in elderly patients with underlying metabolic diseases and end organ damage was significantly higher compared to elderly patients without end organ damage, with or without metabolic disease. The overall incidence of PIH in the present study was 30.14%, which is lower than the 64.8% reported in a previous study conducted on elderly patients in the same hospital[16]. However, it is important to note that the definition of PIH differed between the two studies. In the previous study, PIH was defined as a decrease in MAP of more than 30% from baseline within 20 minutes after induction. In contrast, the present study definition was SBP less than 90 mmHg within 20 minutes. The incidence of PIH in another study with the same definition as the present study was 18.1%[15]. The median age of patients in that study was 60 years, whereas in the present study was 72 years. This data supports the

Table 1. Baseline characteristics and induction profiles of elderly patients by comorbidity status

Variable	Group R: Elderly patient with no DM, HT, DLP (n=315)	Group M: Elderly patient with DM, HT, or DLP without end organ damage (n=688)	Group E: Elderly patient with DM, HT, or DLP with end organ damage (n=387)	p-value
Male sex	154 (48.89)	298 (43.31)	245 (63.31)	<0.001
Age (years); median (IQR)	70 (67, 74)	72 (68, 77)	74 (70, 80)	<0.001
BMI; median (IQR)	22.3 (19.7, 24.7)	23.9 (21.2, 26.6)	23.3 (20.4, 26.2)	<0.001
Hematocrit; median (IQR)	37.5 (33.75, 40.75)	37.5 (33.9, 40.6)	35.6 (31.2, 39.2)	<0.001
Creatinine; median (IQR)	0.8 (0.7, 0.9)	0.8 (0.7, 1.1)	1 (0.8, 1.55)	<0.001
ASA class; n (%)		<0.001		
Class 2	237 (75.24)	410 (59.59)	23 (5.94)	
Class 3	77 (24.44)	278 (40.41)	363 (93.8)	
Class 4	1 (0.32)	0 (0)	1 (0.26)	
Premedication with sedative drug; n (%)	11 (3.49)	30 (4.36)	10 (2.58)	0.325
Type of operation; n (%)				0.2147
Elective	278 (88.25)	615 (89.39)	332 (85.79)	
Emergency	37 (11.75)	73 (10.61)	55 (14.21)	
Anesthetic drug used at induction (multiple answer); n (%)				
Fentanyl	302 (95.87)	672 (97.82)	380 (98.19)	0.1094
Morphine	8 (2.54)	14 (2.03)	5 (1.29)	0.477
Propofol	311 (98.73)	680 (98.84)	371 (95.87)	0.0022
Etomidate	2 (0.63)	4 (0.58)	17 (4.39)	<0.001
Thiopental	6 (1.9)	11 (1.6)	10 (2.58)	0.5313
Ketamine	0 (0)	0 (0)	2 (0.52)	0.0746
Midazolam	5 (1.59)	18 (2.62)	10 (2.58)	0.5801
Cisatracurium	284 (90.16)	612 (88.95)	345 (89.15)	0.8445
Rocuronium	10 (3.17)	29 (4.22)	35 (9.04)	<0.001
Succinylcholine	46 (14.6)	84 (12.21)	15 (3.88)	<0.001
Anesthetic dose at induction; median (IQR)				
Fentanyl (mcg)	75 (50, 75)	75 (50, 100)	75 (50, 75)	0.006829
Morphine (mg)	6.00 (4.00, 6.00)	6.00 (6.00, 10.00)	6.00 (6.00, 6.00)	0.07766
Propofol (mg)	120.0 (100, 150)	120.0 (100, 160)	110.0 (80.0, 140.0)	<0.001
Etomidate (mg)	12 (11, 13)	12.0 (10, 16)	12 (8, 160	0.8976
Thiopental (mg)	175.0 (150, 200)	300.0 (225, 400)	200.0 (162.5, 275.0)	275.0
Midazolam (mg)	1 (0.5, 1.0)	1 (1, 1)	1 (1, 1)	0.3678
Cisatracurium (mg)	8 (6, 10)	8 (8, 10)	8 (8, 10)	0.0008374
Rocuronium (mg)	50 (40, 50)	50 (40, 50)	50 (40, 50)	0.5401
Succinylcholine (mg)	75.00 (70.00, 83.75)	90 (75, 100)	75.00 (72.5, 100)	0.03205
Anesthetic technique		0.7555		
GA; n (%)	303 (96.5)	657 (95.49)	370 (95.61)	
Combine GA with epidural or peripheral NB; n (%)	11 (3.5)	31 (4.51)	17 (4.39)	
Baseline SBP; median (IQR)	136 (123, 147.5)	140 (128, 154)	140 (127, 152)	<0.001
Baseline DBP; mean [SD]	75.61 [10.01]	75.2 [10.37]	74.57 [11.56]	0.4199
Vasopressor drug used during induction; median (IQR)				
Ephedrine (mg)	6 (6, 6)	6 (6, 12)	6 (6, 12)	0.1928
Norepinephrine (mcg)	10 (10, 20)	10 (10, 20)	10 (10, 20)	0.8257
Antihypertensive drug used during extubation; median (IQR)				
Labetalol (mg)	5 (2.5, 5)	5 (5, 5.25)	5 (5, 9.375)	0.2422
Nicardipine (mg)	0.4 (0.2, 0.6)	0.4 (0.2, 0.4)	0.4 (0.4, 0.8)	0.004527

DM=diabetes mellitus; HT=hypertension; DLP=dyslipidemia; BMI=body mass index; ASA=American Society of Anesthesiologists; GA=general anesthesia; NB=nerve blocks; SBP=systolic blood pressure; DBP=diastolic blood pressure; IQR=interquartile range; SD=standard deviation

Table 2. Incidence of post-induction hypotension

Variable	Post-induction normotension (n=971) n (%)	Post-induction hypotension (n=419) n (%)	Crude OR (95% CI)	Adjusted OR (95% CI)
Group R (n=315)	227 (72.1)	88 (27.9)	Reference	Reference
Group M (n=688)	493 (71.7)	195 (28.3)	0.84 (0.67 to 1.06)	1.05 (0.78 to 1.43)
Group E (n=387)	251 (64.9)	136 (35.1)	1.38 (1.07 to 1.77)	1.49 (1.06 to 2.08)

OR=odd ratio; CI=confidence interval

Group R: Elderly patient; Group M: Elderly patient with DM, HT, or DLP; Group E: Elderly patient with DM, HT, or DLP with end organ damage

Group M, Group E, sex, age, use of propofol, use of etomidate, and baseline SBP were adjusted for the odds ratio.

Table 3. Incidence of hypertension during emergence/extubation

Variable	Normotension during emergence/ extubation (n=1,183); n (%)	Hypertension during emergence/ extubation (n=207); n (%)	Crude OR (95% CI)	Adjusted OR (95% CI)
Group R (n=315)	290 (92.1)	25 (7.9)	reference	reference
Group M (n=688)	586 (85.2)	102 (14.8)	2.02 (1.3 to 3.26)	1.93 (1.23 to 3.12)
Group E (n=387)	307 (79.3)	80 (20.7)	3.02 (1.9 to 4.96)	2.92 (1.82 to 4.84)

OR=odd ratio; CI=confidence interval

Group R: Elderly patient; Group M: Elderly patient with DM, HT, or DLP; Group E: Elderly patient with DM, HT, or DLP with end organ damage

Group M, Group E, sex, and age were adjusted for the odds ratio.

notion that age is an independent variable for PIH compared to the general population[13-15].

The definition of PIH in the present study was based solely on SBP thresholds and did not consider the administration of vasopressors. Therefore, some patients may have met the criteria for PIH based on SBP but did not receive vasopressors, while others who did not meet the SBP threshold may have been treated with vasopressors based on clinical judgment.

Metabolic disease and end-organ damage were independent variables for predicting PIH in elderly patients. The authors adjusted for age, a known risk factor for PIH[13-15]. Additionally, the authors accounted for the use of etomidate and propofol, as previous studies have shown that etomidate is associated with less IOH compared to propofol[17]. Propofol, on the other hand, is an independent predictor of hypotension following anesthetic induction, compared to thiopental and etomidate[13]. However, the present study found that etomidate was used more frequently in Group E, which consisted of patients with a higher burden of comorbidities. This suggests the possibility of selection bias, as anesthesiologists may have preferentially chosen etomidate for higher-risk patients, a known limitation of retrospective study designs. Another approach is a lidocaine-based induction regimen, which has been shown to reduce PIH in older patients compared to fentanyl-based regimens[18].

Metabolic diseases and end-organ damage was independent variables associated with the use of vasopressor drugs during the induction of anesthesia in elderly patients. These results are similar to those study by Polderman et al., which investigated the effects of cardiovascular autonomic neuropathy (CAN) on post-induction hemodynamic variables in patients with and without diabetes. That study showed that moderate CAN was associated with higher vasopressor requirements in major abdominal surgery[19]. However, there were differences in the findings regarding post-induction risk. While Polderman et al. found that diagnosing CAN did not identify patients at risk for PIH, the present research indicated that metabolic diseases and end-organ damage are significant risk factors for PIH. Metabolic diseases and end-organ damage were independent variables associated with the use of vasopressor drugs during the induction of anesthesia in elderly patients. This reflects their clinical link, as hypotension often necessitates the use of vasopressors to maintain perfusion pressure and reduce the risk of end-organ hypoperfusion.

Metabolic diseases, with or without end-organ damage, were independent variables for hypertension and the use of antihypertensive drugs during emergence or extubation in elderly patients. This is a new finding, as no previous studies have mentioned this point. Luo et al. identified factors responsible for unanticipated hypertension during emergence from general anesthesia, including age of 65 years or older, female gender, intraoperative hypertension, postoperative pain, and agitation[20]. After adjusting for age and gender, the present research found metabolic diseases are significant risk factors for hypertension and the use of antihypertensive drugs during emergence or extubation. During emergence from anesthesia, anesthesiologists can use esmolol to prevent extubation-related complications such as hypertension and tachycardia[21].

Anesthesiologists are concerned with maintaining hemodynamic stability during general anesthesia to reduce the risk of postoperative complications. However, recent research indicates that IOH, defined as MAP of 65 mmHg or less, is associated with postoperative organ complications, whereas PIH does not appear to have the same significance[22]. Therefore, further research should focus on both PIH and IOH and their relationship to postoperative complications in this patient group. Moreover, elderly patients may experience both IOH and hypertension. This observation can generate a research question to compare postoperative complications in patients who had only IOH versus those who had both IOH and hypertension.

Limitation

The strength of the present study was the complete follow-up of all patients until discharged from the postanesthetic care unit (PACU), which helped minimize selection bias. The authors monitored clinical outcomes through hemodynamic parameters during the intraoperative period and in the PACU. However, limitations should be considered when interpreting the present study findings. Firstly, blood pressure monitoring was recorded every five minutes in the anesthetic record form, which limited the ability to detect hypotension compared to real-time hemodynamic monitoring. Furthermore, there was potential under-detection of metabolic diseases and end organ damage in elderly patients who had not undergone health check-ups before the operation. Therefore, the possible introduction of information bias from outcome misclassification and exposure misclassification cannot be precluded from the present study. Secondly, the present study only included data from one tertiary hospital, which limited the generalizability of the study findings as patient characteristics and clinical practices could differ from those in other institutions or regions. Thirdly, there may have been unrecognized confounders that the authors did not or could not adjust for in the multivariate logistic regression analysis. The limitations of the retrospective data include that some MAP values were missing. Therefore, the authors focused on SBP, however, the use of MAP may be more appropriate for both clinical research and practice.

Conclusion

The incidence of PIH and the use of vasopressor drugs in elderly patients with underlying metabolic diseases and end-organ damage was significantly higher compared to the elderly patients without end-organ damage, regardless of the presence of metabolic diseases. Metabolic diseases and end-organ damage were independent variables for PIH and the use of vasopressor drugs during the induction of anesthesia in elderly patients.

What is already known about this topic?

Elderly patients and those with DM are known to be at increased risk for PIH.

What does this study add?

This study investigates how the severity of metabolic disease influences the occurrence of PIH in elderly patients.

Acknowledgement

The authors would like to acknowledge Ms. Jirawan Jayuphan for her assistance in statistical analysis.

Funding disclosure

The authors have no funding to declare.

Conflicts of interest

All authors declare that there are no conflicts of interest.

References

1. Alvis BD, Hughes CG. Physiology considerations in geriatric patients. Anesthesiol Clin 2015;33:447-56.
2. Fisher VL, Tahrani AA. Cardiac autonomic neuropathy in patients with diabetes mellitus: current perspectives. Diabetes Metab Syndr Obes 2017;10:419-34.
3. Ueda K, Janiczek DM, Casey DP. Arterial stiffness predicts general anesthesia-induced vasopressor-resistant hypotension in patients taking angiotensin-converting enzyme inhibitors. J Cardiothorac Vasc Anesth 2021;35:73-80.
4. Renew JR. Perioperative management of hyperlipidemia medications. Curr Clin Pharmacol 2017;12:152-6.
5. Lin HQ, Wu JY, Chen ML, Chen FQ, Liao YJ, Wu YT, et al. Prevalence of dyslipidemia and prediction of 10-year CVD risk among older adults living in southeast coastal regions in China: a cross-sectional study. Clin Interv Aging 2019;14:1119-29.

6. Delbari A, Naderyan Feli S, Amirabadizadeh AR, Niroomand M, Bidkhori M. Prevalence and associated factors of dyslipidemia in elderly people: Results from the Ardakan Cohort Study on Ageing, Iran. PLoS One 2024;19:e0306388.
7. Randrianarisoa RMF, Abdoul-Kader A, Ravelonjatovo MF, Randriamihangy NA. Prevalence and characteristics of dyslipidemia in a hospital in Madagascar. Cureus 2024;16:e73424.
8. Das U, Kar N. Prevalence and risk factor of diabetes among the elderly people in West Bengal: evidence-based LASI 1st wave. BMC Endocr Disord 2023;23:170. doi: 10.1186/s12902-023-01421-3.
9. Lloyd-Jones DM, Evans JC, Levy D. Hypertension in adults across the age spectrum: current outcomes and control in the community. JAMA 2005;294:466-72.
10. Bijker JB, Persoon S, Peelen LM, Moons KG, Kalkman CJ, Kappelle LJ, et al. Intraoperative hypotension and perioperative ischemic stroke after general surgery: a nested case-control study. Anesthesiology 2012;116:658-64.
11. van Waes JA, van Klei WA, Wijeysundera DN, van Wolfswinkel L, Lindsay TF, Beattie WS. Association between intraoperative hypotension and myocardial injury after vascular surgery. Anesthesiology 2016;124:35-44.
12. Walsh M, Devereaux PJ, Garg AX, Kurz A, Turan A, Rodseth RN, et al. Relationship between intraoperative mean arterial pressure and clinical outcomes after noncardiac surgery: toward an empirical definition of hypotension. Anesthesiology 2013;119:507-15.
13. Reich DL, Hossain S, Krol M, Baez B, Patel P, Bernstein A, et al. Predictors of hypotension after induction of general anesthesia. Anesth Analg 2005;101:622-8.
14. Jor O, Maca J, Koutna J, Gemrotova M, Vymazal T, Litschmannova M, et al. Hypotension after induction of general anesthesia: occurrence, risk factors, and therapy. A prospective multicentre observational study. J Anesth 2018;32:673-80.
15. Südfeld S, Brechnitz S, Wagner JY, Reese PC, Pinnschmidt HO, Reuter DA, et al. Post-induction hypotension and early intraoperative hypotension associated with general anaesthesia. Br J Anaesth 2017;119:57-64.
16. Sutthibenjakul K, Chatmongkolchart S. Risk factors for postinduction hypotension among elderly patients undergoing elective non-cardiac surgery under general anesthesia. J Health Sci Med Res [Internet]. 2021 Mar 31 [cited 2024 Dec 5]; Available from: https://www.jhsmr.org/index.php/jhsmr/article/view/795.
17. Lu Z, Zheng H, Chen Z, Xu S, Chen S, Mi W, et al. Effect of etomidate vs propofol for total intravenous anesthesia on major postoperative complications in older patients: A randomized clinical trial. JAMA Surg 2022;157:888-95.
18. Amin SM, Hasanin A, ElSayed OS, Mostafa M, Khaled D, Arafa AS, et al. Comparison of the hemodynamic effects of opioid-based versus lidocaine-based induction of anesthesia with propofol in older adults: a randomized controlled trial. Anaesth Crit Care Pain Med 2023;42:101225. doi: 10.1016/j.accpm.2023.101225.
19. Polderman JAW, Sperna Weiland NH, Klaver MH, Biginski J, Horninge M, Hollmann MW, et al. The prevalence of cardiovascular autonomic neuropathy and its influence on post induction hemodynamic variables in patients with and without diabetes; A prospective cohort study. PLoS One 2018;13:e0207384.
20. Luo D, Zhou Y, Yue Z, Shi M, Shao L, Hui K, et al. Factors responsible for unanticipated hypertension during emergence from general anesthesia. Chin Med J (Engl) 2023;136:2263-5.
21. Mendon AF, Barreto Filho JH, Hungria M, Magalh Es TC. Efficacy of a single dose of esmolol to prevent extubation-related complications during emergence from anesthesia: a randomized, double-blind, placebo-controlled trial. Braz J Anesthesiol 2023;73:426-33.
22. Czajka S, Putowski Z, Krzych Ł J. Post-induction hypotension and intraoperative hypotension as potential separate risk factors for the adverse outcome: a cohort study. J Anesth 2023;37:442-50.