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Effect Of Propofol On Cardiovascular Stability In Hypertensive Patients Undergoing Cholesyctectomy Surgery

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Abstract

Background
Propofol is a commonly used intravenous anesthetic due to its rapid onset and favorable recovery profile. However, its potential to reduce blood pressure and myocardial contractility can challenge cardiovascular stability, particularly in hypertensive patients undergoing surgery. Ensuring perioperative hemodynamic stability is critical to prevent complications and improve surgical outcomes.
Objective
To evaluate the effect of Propofol on cardiovascular stability in hypertensive patients undergoing elective cholecystectomy, focusing on perioperative fluctuations in blood pressure, mean arterial pressure, and heart rate.
Methodology
A **cross-sectional study** was conducted at **Hayatabad Medical Complex, Peshawar** over four months. A total of **120 hypertensive patients** undergoing elective cholecystectomy were recruited using **non-probability consecutive sampling**. Inclusion criteria included patients aged 18–65 years with controlled hypertension who provided informed consent. Hemodynamic parameters (systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate (HR) were recorded at **baseline (pre-induction), during Propofol induction, intraoperatively, and postoperatively** using standardized monitoring equipment. Data were collected via a structured proforma and analyzed using **SPSS version 27**.

Descriptive statistics summarized baseline characteristics, and inferential tests including paired t-tests, chi-square tests, and repeated measures ANOVA were applied. A *p*-value <0.05 was considered statistically significant.

Results

Of the 120 participants, **54 (45%) were male** and **66 (55%) were female,** with the majority aged 41–50 years. Propofol induction resulted in significant reductions in SBP (↓11.3%), DBP (↓13.6%), and MAP (↓13.2%), while HR showed mild decreases. Most patients remained hemodynamically stable intraoperatively, with only **15% experiencing transient hypotension** and **13.3% requiring vasopressors.** Arrhythmias were rare (13.3%) and mostly benign. Postoperative recovery demonstrated return to baseline values, indicating rapid cardiovascular stabilization.

Conclusion

Propofol provides effective cardiovascular stability in controlled hypertensive patients undergoing elective cholecystectomy. Although mild hypotension occurs, it is manageable with standard interventions. These findings support Propofol as a safe induction agent when combined with vigilant perioperative monitoring.

Introduction

Hypertension is one of the most prevalent chronic conditions worldwide and is a major contributor to perioperative morbidity and mortality, especially in surgical patients undergoing general anesthesia [1]. As surgical volumes continue to rise, particularly for abdominal surgeries such as cholecystectomy, the safe and effective anesthetic management of hypertensive patients has become increasingly important. Cholecystectomy especially laparoscopic cholecystectomy induces significant physiological changes due to pneumoperitoneum, patient positioning, and surgical stress, all of which can provoke fluctuations in blood pressure, heart rate, and systemic vascular resistance [2]. These hemodynamic changes pose particular challenges in hypertensive patients who may demonstrate exaggerated responses to surgical stimulation because of altered vascular compliance and impaired autonomic reflexes [3]. Such instability places them at increased risk of perioperative complications including myocardial ischemia, arrhythmias, and cerebrovascular events [4]. Propofol is one of the most commonly used intravenous induction agents due to its rapid onset, favorable recovery profile, and antiemetic properties [5]. However, it is also known to cause reductions in systemic vascular resistance, myocardial contractility, and arterial blood pressure, raising concerns about its use in patients with preexisting cardiovascular disease such as hypertension [6]. While its vasodilatory effects may be beneficial in attenuating hypertensive surges during laryngoscopy or surgical manipulation, excessive hypotension is a frequent adverse event associated with propofol, especially among hypertensive individuals with impaired baroreceptor sensitivity [7]. Because hypertensive patients often have a right-shifted autoregulatory curve, they may be more susceptible to organ hypoperfusion when blood pressure falls below their baseline range [8]. These factors create uncertainty about the overall cardiovascular stability of propofol in this population.

The interaction between hypertension, anesthetic agents, and the stress of surgery is complex. Laryngoscopy and endotracheal intubation critical steps during induction can trigger a significant sympathetic surge, resulting in marked elevations in blood pressure and heart rate [9]. In hypertensive patients, these responses are often exaggerated, potentially leading to acute cardiac events [10]. Propofol has been shown to blunt these pressor responses more effectively than many other induction agents due to its central sympatholytic action [11]. However, some studies suggest that hypertensive patients may experience more pronounced hypotension after

propofol administration because of their diminished capacity for compensatory vasoconstriction [12]. These contrasting findings highlight the need for clearer evidence regarding propofol's hemodynamic effects in this high-risk subgroup. Cholecystectomy, particularly in its laparoscopic form, introduces additional cardiovascular challenges linked to carbon dioxide pneumoperitoneum. Increased intra-abdominal pressure elevates systemic vascular resistance and mean arterial pressure, while also reducing venous return and cardiac output [13]. Patients with hypertension often have reduced cardiovascular reserve and may not adequately compensate for such changes [14]. Propofol's ability to reduce sympathetic tone can counteract some of the hypertensive effects of pneumoperitoneum, helping maintain hemodynamic stability [15]. However, excessive vasodilation may lead to critical drops in perfusion pressure, posing risks for those who depend on higher baseline pressures such as patients with long-standing hypertension or left ventricular hypertrophy [16].

Despite numerous studies evaluating propofol's hemodynamic effects in general populations, research focusing specifically on hypertensive patients undergoing cholecystectomy remains limited. Much of the available literature includes either normotensive individuals or mixed patient groups, making it difficult to generalize findings to hypertensive populations [17]. Furthermore, variations in propofol dosage, rate of administration, co-administered analgesics, and intraoperative fluid strategies introduce additional inconsistencies that complicate interpretation [18]. Therefore, there is a pressing need for targeted research that examines propofol's cardiovascular effects exclusively in hypertensive patients undergoing cholecystectomy.

Methodology

Study Design

A cross-sectional study was conducted to assess the effect of Propofol on cardiovascular stability in hypertensive patients undergoing elective cholecystectomy.

Study Setting

The study took place in Hayatabad Medical Complex, Peshawar.

Study Duration

The study was completed over 4 months.

Sample Size

A total of 120 patients were included, calculated using the WHO Sample Size Calculator with a 95% confidence interval.

Sampling Technique

Non-probability consecutive sampling was used, enrolling all eligible hypertensive patients until the required sample size was reached.

Inclusion Criteria

Patients aged 18–65 years with controlled hypertension on medication, undergoing elective cholecystectomy under general anesthesia, and who provided informed consent.

Exclusion Criteria

Patients with uncontrolled hypertension, cardiac diseases, arrhythmias, recent beta-blocker/vasodilator use, pregnant women, emergency surgeries, or incomplete data

Ethical Considerations
Ethical approval was obtained from the Ethical Review Committee of Superior University, Lahore. Written informed consent was taken from all participants, and confidentiality was ensured using coded identifiers and secure data storage. Participants retained the right to withdraw at any time, and no additional risks beyond routine anesthesia were imposed.

Data Collection Procedure
Data were collected prospectively using a structured Performa documenting demographics, hypertension history, anesthetic details, and hemodynamic parameters (SBP, DBP, MAP, HR). Readings were recorded at baseline, during Propofol induction, intraoperatively including pneumoperitoneum and postoperatively using standardized monitoring equipment. Secondary events such as hypotension, hypertension, arrhythmias, and vasopressor or antihypertensive use were also documented.

Data Analysis
Data will be analyzed using SPSS version 27. Descriptive statistics (mean ± SD, frequencies, percentages) will summarize patient characteristics. The Shapiro–Wilk test will assess normality. Paired t-test/Wilcoxon Signed-Rank test will compare pre- and post-induction values; independent t-test/Mann–Whitney U test will analyze subgroup differences; Chi-square/Fisher's Exact test will assess categorical outcomes; and repeated measures ANOVA will evaluate hemodynamic trends over time. A p-value < 0.05 will be considered statistically significant.

Result:
Gender-Wise Distribution of Participants

Gender	**Frequency**	**Percentage (%)**
Male	54	45.0%
Female	66	55.0%
Total	**120**	**100%**

Age-Wise Distribution of Participants

Age Group (years)	**Frequency**	**Percentage (%)**
18–30	14	11.7%
31–40	24	20.0%
41–50	42	35.0%
51–60	32	26.7%
>60	8	6.6%
Total	**120**	**100%**

Baseline Hemodynamic Parameters

Parameter	**Mean ± SD**
SBP (mmHg)	142 ± 12
DBP (mmHg)	88 ± 9
MAP (mmHg)	106 ± 8
HR (bpm)	82 ± 7

Hemodynamic Response During Propofol Induction

Parameter	**Pre-Induction Mean ± SD**	**Post-Induction Mean ± SD**	**% Change**

SBP (mmHg)	142 ± 12	126 ± 10	↓ 11.3%
DBP (mmHg)	88 ± 9	76 ± 8	↓ 13.6%
MAP (mmHg)	106 ± 8	92 ± 7	↓ 13.2%
HR (bpm)	82 ± 7	78 ± 6	↓ 4.9%

Hemodynamic Trends During Intraoperative Period

Parameter	Mean ± SD
SBP (mmHg)	132 ± 11
DBP (mmHg)	82 ± 7
MAP (mmHg)	101 ± 8
HR (bpm)	84 ± 6

Postoperative Hemodynamic Recovery

Parameter	Mean ± SD
SBP (mmHg)	138 ± 12
DBP (mmHg)	86 ± 8
MAP (mmHg)	104 ± 7
HR (bpm)	81 ± 7

Incidence of Hemodynamic Events

Parameter	Frequency	Percentage (%)
Intraoperative Hypotension	18	15.0%
Intraoperative Hypertension	12	10.0%
Tachycardia	10	8.3%
Bradycardia	6	5.0%

Use of Vasopressors or Antihypertensive Medications

Intervention	Frequency	Percentage (%)
Vasopressors (Ephedrine/Phenylephrine)	16	13.3%
Intraoperative Antihypertensives	10	8.3%
No Additional Medication Required	94	78.3%

Occurrence of Arrhythmias

Type of Arrhythmia	Frequency	Percentage (%)
PVCs (Occasional)	5	4.2%
Sinus Tachycardia	7	5.8%
Sinus Bradycardia	4	3.3%
No Arrhythmias	104	86.7%

Discussion:

The present study evaluated the effect of Propofol on cardiovascular stability in hypertensive patients undergoing elective cholecystectomy and demonstrated that Propofol maintained overall hemodynamic stability with predictable and manageable fluctuations in blood pressure and heart rate. The demographic distribution in this study revealed that a majority of participants were female (55%), which aligns with global epidemiological data showing a higher incidence of gallbladder diseases among women, often due to hormonal factors influencing biliary cholesterol

saturation (19). Additionally, most participants fell within the 41–50-year age group, representing the typical age range in which hypertension and gallbladder pathology commonly coexist (20). Baseline hemodynamic measurements in this study reflected controlled hypertension, with mean systolic and diastolic pressures of 142 ± 12 mmHg and 88 ± 9 mmHg, respectively. Following Propofol induction, there was a significant reduction in systolic, diastolic, and mean arterial pressure values, with decreases of 11.3%, 13.6%, and 13.2% respectively. These findings are consistent with previous literature indicating that Propofol causes dose-dependent vasodilation and myocardial depression, leading to reduced systemic vascular resistance and arterial pressure (21). Nevertheless, the decline observed in this study remained within acceptable clinical limits, highlighting Propofol's suitability for controlled hypertensive patients undergoing intermediate-risk procedures such as cholecystectomy.

During the intraoperative period, particularly after pneumoperitoneum establishment, a mild compensatory rise in blood pressure was observed but remained stable. This is consistent with the physiological response to increased intra-abdominal pressure, which can transiently elevate systemic vascular resistance and arterial pressure (22). Despite these physiological stressors, the hemodynamic response remained well-regulated, suggesting that Propofol provided adequate cardiovascular stability in combination with vigilant intraoperative monitoring. Similar findings have been noted by other authors who observed that Propofol blunts sympathetic responses to surgical stimuli and effectively attenuates fluctuations caused by pneumoperitoneum (23). Postoperative recovery demonstrated a return of hemodynamic parameters toward baseline values, confirming Propofol's short duration of action and rapid clearance. This supports its well-established pharmacokinetic profile, making it ideal for procedures requiring smooth induction and quick recovery without prolonged cardiovascular depression (24). The fact that most patients remained hemodynamically stable throughout the perioperative period further reinforces its safety profile in hypertensive individuals.

Regarding intraoperative events, 15% of patients developed transient hypotension, which aligns with documented evidence reporting that 10–30% of patients may experience Propofol-induced hypotension during induction (25). However, the majority of these episodes were mild and easily managed, with only 13.3% of patients requiring vasopressors such as ephedrine or phenylephrine. This is consistent with prior studies emphasizing the effectiveness of vasopressors in counteracting Propofol-related hypotension without significant complications (26). Importantly, 61.7% of patients experienced no significant hemodynamic event at all, illustrating the overall stability afforded by Propofol in this population. Arrhythmias occurred in a small proportion of patients (13.3%), mostly benign sinus tachycardia, bradycardia, or occasional PVCs. These occurrences fall within expected ranges, as Propofol is known to have minimal proarrhythmic potential compared with other induction agents (27). Previous investigations have similarly documented that Propofol generally preserves sinus rhythm and rarely causes clinically significant arrhythmias except in individuals with severe underlying cardiac disease (28). The low frequency and benign nature of arrhythmias in this study therefore reinforce the suitability of Propofol in hypertensive patients without severe cardiac comorbidities.

A key strength of this study is its real-world applicability in a high-volume tertiary care surgical setting. The findings demonstrate that when hypertensive patients are properly optimized preoperatively and carefully monitored, Propofol can be used safely with minimal cardiovascular risk. Moreover, the low requirement for pharmacologic intervention during surgery reflects both the stability of the anesthetic technique and the effectiveness of monitoring protocols implemented. These

outcomes support the recommendations of contemporary anesthetic guidelines which endorse Propofol as an appropriate induction agent for hypertensive patients undergoing general anesthesia due to its controllability and predictable pharmacodynamics (29).

However, it is important to acknowledge that hypertensive patients have increased sensitivity to anesthetic-induced hemodynamic changes due to altered vascular compliance and autonomic regulation (30). Therefore, despite the favorable outcomes demonstrated in this study, anesthesiologists must remain cautious, especially in patients with uncontrolled hypertension or cardiac complications, who were excluded from this population.

Conclusion:

The study demonstrates that **Propofol provides effective cardiovascular stability** in hypertensive patients undergoing elective cholecystectomy. While it causes predictable reductions in systolic, diastolic, and mean arterial pressures during induction, these changes are generally mild and clinically manageable. Heart rate variations and arrhythmias were minimal, and the incidence of hypotension requiring vasopressor support was low. Overall, Propofol appears to be a safe and reliable induction agent for controlled hypertensive patients, provided that careful perioperative monitoring and appropriate interventions are in place. These findings reinforce the importance of individualized anesthetic planning to optimize hemodynamic stability and reduce perioperative cardiovascular risks in this vulnerable population.

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