Effect of Preoperative Beta-Blockers on Anaesthesia Drug Requirements in Cardiac Surgery Patients.

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Abstract

Background:

Beta-blockers are routinely used in cardiac surgery for their cardioprotective effects. Their impact on anesthetic drug requirements, however, remains underexplored. This study aimed to evaluate the effect of preoperative beta-blocker therapy on intraoperative anesthetic consumption and perioperative stability.

Methods:

In this prospective observational study, 56 adult patients undergoing elective cardiac surgery were divided into two groups: those receiving preoperative beta-blockers (≥7 days) and those not. Intraoperative drug usage (propofol, fentanyl, sevoflurane), hemodynamic parameters, extubation time, and adverse events were recorded. Data were analyzed using appropriate statistical tests.

Results:

Patients in the beta-blocker group required significantly lower doses of propofol ($p < 0.001$), fentanyl ($p = 0.002$), and sevoflurane ($p < 0.001$). They showed better intraoperative hemodynamic control and fewer hypertensive/tachycardic episodes ($p = 0.03$). Extubation was earlier, and recovery scores were higher, though not statistically significant. No increase in adverse events was observed.

Conclusion:

Preoperative beta-blocker therapy reduces anesthetic drug requirements and enhances intraoperative stability in cardiac surgery patients, supporting its role as part of a comprehensive perioperative care strategy.

Keywords:

Beta-blockers, cardiac anesthesia, anesthetic requirement, hemodynamic stability, cardiac surgery.

Introduction

Cardiac surgeries are complex procedures that demand precise hemodynamic management to minimize perioperative risk and improve patient outcomes. Anesthetic drug requirements during these surgeries are influenced by several factors, including baseline cardiovascular status, medications, and stress responses. Among these, the use of preoperative beta-blockers has emerged as a critical intervention in modulating intraoperative physiology. Beta-blockers attenuate sympathetic nervous system activity by blocking β-adrenergic receptors, leading to decreased heart rate, myocardial oxygen consumption, and systemic blood pressure—factors that can significantly alter anesthetic depth and drug requirements [1]. On a global scale, cardiovascular disease remains the leading cause of death, with over 17.9 million deaths annually, many of which require surgical interventions such as coronary artery bypass grafting (CABG) or valve replacements [2]. The use of beta-blockers in cardiac surgery is not only aimed at reducing perioperative myocardial ischemia and arrhythmias but may also have implications for anesthetic sparing—an area that remains underexplored [3]. Studies from Western populations suggest that beta-blockade blunts the hemodynamic response to laryngoscopy and surgical stimuli, which in turn could reduce the dose requirements for volatile anesthetics, intravenous induction agents, and opioids [4]. In the Indian context, cardiovascular diseases have seen a steep rise, with estimates suggesting that over 30 million Indians suffer from heart disease, and more than 200,000 cardiac surgeries are performed annually in tertiary centers [5]. Notably, Indian patients often present at a younger age with more complex comorbidities, including hypertension, diabetes, and reduced ejection fraction, necessitating tight perioperative control [6]. Despite the widespread use of beta-blockers in cardiac care protocols, there is a paucity of data from India regarding their impact on anesthetic drug requirements during surgery. Indian studies have primarily focused on the cardioprotective role of beta-blockers, with little emphasis on their pharmacodynamic interactions with anesthetic agents.

Furthermore, economic and resource considerations in India make optimization of anesthetic drug use highly relevant. Volatile anesthetics and intravenous agents constitute a significant part of operative costs. If beta-blockers can reliably reduce drug requirements without compromising safety, they could offer both clinical and economic advantages, especially in high-volume cardiac centers. Understanding these interactions in Indian patients is particularly important due to genetic, metabolic, and pharmacokinetic variations, which may influence drug sensitivity and dosing requirements [7].

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This study is therefore designed to evaluate the effect of preoperative beta-blockers on intraoperative anesthetic drug requirements in Indian cardiac surgery patients. By comparing drug usage between patients on beta-blockers and those not receiving them preoperatively, this research aims to generate evidence-based recommendations that are relevant to both global clinical practice and India's evolving cardiac surgical landscape.

Aim

To evaluate the effect of preoperative beta-blocker administration on intraoperative anesthetic drug requirements in patients undergoing elective cardiac surgery.

Objectives

Primary Objective:

- To compare the total intraoperative anesthetic drug (induction and maintenance agents) requirements between patients receiving preoperative beta-blockers and those not on beta-blockers.

Secondary Objectives:

- To assess intraoperative hemodynamic stability in both groups.
- To evaluate the time to extubation and recovery profile post-surgery. **Materials and**

Methods Study Design:

Prospective, observational, comparative study.

Study Population:

Patients aged ≥18 years undergoing elective cardiac surgeries (e.g., CABG, valve replacement) under general anesthesia.

Inclusion Criteria:

- Adult patients (≥18 years)
- Elective cardiac surgery under general anesthesia with cardiopulmonary bypass
- Informed consent obtained
- Availability of complete intraoperative drug and monitoring records **Exclusion**

Criteria:

- Emergency surgeries
- Patients on other CNS-acting drugs (e.g., sedatives, antipsychotics)
- History of chronic opioid or sedative use
- Severe left ventricular dysfunction (EF <30%)
- Contraindications to beta-blockers (e.g., asthma, high-degree AV block) •
 Intraoperative conversion to off-pump or unplanned procedures

Group Allocation:

- **Group A (Beta-blocker group):** Patients on oral beta-blockers for ≥7 days preoperatively

- **Group B (Non-beta-blocker group):** Patients not on any beta-blocker therapy
  Sample Size Calculation:

Based on previous studies that demonstrated a 20% reduction in anesthetic requirement in beta-blocker users with an expected standard deviation of 25%, the sample size was calculated using the formula:

$$n=2(Z\alpha/2+Z\beta)^2 \times \sigma^2 / (\mu1-\mu2)^2$$

Where:

- α = 0.05 (95% confidence, Z = 1.96)
- β = 0.2 (80% power, Z = 0.84)
- σ = standard deviation (25%)
- Δ = minimum detectable difference (20%) **=24.5**

Sample size per group: 25

Total sample size (including 10% dropout): 28 × 2 = 56 patients

Data Collection Parameters:

- Demographics (age, sex, comorbidities)
- Beta-blocker type, dose, duration
- Anesthetic agents used (propofol, sevoflurane, opioids)
- Hemodynamic parameters (HR, BP) at induction, skin incision, CPB initiation, and post-bypass

- BIS (if used)
- Time to extubation
- Recovery profile (e.g., Aldrete score)

Statistical Analysis:

- Data analyzed using SPSS version 25.
- Continuous variables: Mean ± SD; compared using t-test or Mann–Whitney U test
- Categorical variables: Frequency (%); compared using Chi-square or Fisher's exact test
- p-value < 0.05 considered statistically significant.

RESULTS

Table 1: Baseline Characteristics of the Study Population

Parameter	Beta-Blocker Group (n = 28)	Non-Beta-Blocker Group (n = 28)	p-value
Age (years, mean ± SD)	60.4 ± 8.1	59.8 ± 7.5	0.71 (t-test)
Male (%)	20 (71.4%)	18 (64.3%)	0.56 (Chisquare)
Diabetes Mellitus (%)	14 (50.0%)	12 (42.9%)	0.59 (Chisquare)
Hypertension (%)	16 (57.1%)	15 (53.6%)	0.79 (Chisquare)
Left Ventricular EF (%)	50.2 ± 6.3	49.7 ± 6.8	0.73 (t-test)

Interpretation:

There were no statistically significant differences between the beta-blocker and non-betablocker groups in terms of age, gender distribution, comorbidities, or baseline left ventricular function. This indicates that the two groups were comparable at baseline, minimizing selection bias and allowing for a valid comparison of anesthetic outcomes

Table 2: Intraoperative Anesthetic Drug Requirements

Parameter	Beta-Blocker Group (n = 28)	Non-Beta-Blocker Group (n = 28)	p-value
Propofol (mg, mean ± SD)	78.6 ± 12.5	95.3 ± 15.8	**<0.001 (ttest)**
Fentanyl (µg, mean ± SD)	280 ± 55	330 ± 60	**0.002 (ttest)**
Sevoflurane MAC (%)	0.8 ± 0.15	1.1 ± 0.22	**<0.001 (ttest)**

Interpretation:

Patients who received preoperative beta-blockers required significantly lower doses of induction (propofol), opioid (fentanyl), and maintenance (sevoflurane) anesthetic agents compared to those who did not. This suggests that preoperative beta-blockade has a notable anesthetic-sparing effect, likely due to attenuation of the sympathetic response and reduced metabolic demand.

Table 3: Intraoperative Hemodynamic Stability

Parameter	Beta-Blocker Group (n = 28)	Non-Beta-Blocker Group (n = 28)	p-value
Mean HR at induction (bpm)	68 ± 9.4	82 ± 10.7	**<0.001 (ttest)**
MAP at incision (mmHg)	78.5 ± 7.2	84.6 ± 8.3	**0.004 (t-test)**
Episodes of HTN or tachycardia	3 (10.7%)	10 (35.7%)	**0.03 (Chisquare)**

Interpretation:

The beta-blocker group demonstrated better intraoperative hemodynamic control, with significantly lower heart rates and mean arterial pressures during key operative periods. Additionally, there were fewer episodes of hypertension and tachycardia in this group, highlighting the role of beta-blockers in promoting cardiovascular stability during anesthesia for cardiac surgery.

Table 4: Recovery Profile

Parameter	Beta-Blocker Group (n = 28)	Non-Beta-Blocker Group (n = 28)	p-value
Time to extubation (min)	290 ± 35	310 ± 42	0.06 (t-test)
Aldrete score ≥ 9 at 30 min (%)	24 (85.7%)	20 (71.4%)	0.21 (Chisquare)

Interpretation:

Although the difference did not reach statistical significance, patients pretreated with betablockers showed a trend toward earlier extubation and higher early recovery scores. This may reflect reduced anesthetic consumption, leading to faster emergence from anesthesia and improved early postoperative recovery profiles.

Table 5: Adverse Effects and Events

Event	Beta-Blocker Group (n = 28)	Non-Beta-Blocker Group (n = 28)	p-value
Hypotension requiring vasopressors	4 (14.3%)	6 (21.4%)	0.48 (Chisquare)
Bradycardia (HR <50 bpm)	3 (10.7%)	1 (3.6%)	0.30 (Chisquare)
Reintubation	0 (0%)	1 (3.6%)	0.31 (Fisher's Exact)

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Interpretation:

There was no significant increase in adverse intraoperative events, such as bradycardia or hypotension, in the beta-blocker group. This indicates that preoperative beta-blocker use is safe and well-tolerated in the perioperative setting when appropriately managed, without increasing the risk of major anesthesia-related complications.

Discussion

This prospective comparative study evaluated the impact of preoperative beta-blocker therapy on anesthetic drug requirements in patients undergoing elective cardiac surgery. The findings demonstrated that patients receiving beta-blockers required significantly lower doses of induction and maintenance anesthetics, had greater intraoperative hemodynamic stability, and exhibited a trend toward faster recovery, without a statistically significant increase in adverse effects. Our results showed a marked reduction in propofol, fentanyl, and sevoflurane usage among patients who received beta-blockers preoperatively. These findings are consistent with prior studies indicating that beta-adrenergic blockade blunts the sympathetic response to surgical stimuli, thereby decreasing the need for higher anesthetic depths to maintain cardiovascular stability [8]. Mraovic et al. observed similar anesthetic-sparing effects in CABG patients, with reduced propofol and opioid requirements in those on beta-blocker therapy [9].

The lower MAC values of sevoflurane observed in the beta-blocker group suggest that these patients reach adequate anesthetic depth with reduced inhalational agent concentrations. This is in agreement with studies showing that beta-blockers reduce the minimum alveolar

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concentration (MAC) of volatile agents by modulating autonomic tone and reducing stress hormone responses [10]. Furthermore, these agents may enhance the reliability of depth-ofanesthesia monitoring using BIS, facilitating precise titration of anesthetics [11]. Importantly, the beta-blocker group also exhibited superior intraoperative hemodynamic control, with significantly lower heart rates and fewer episodes of hypertension or tachycardia. These effects are beneficial during cardiac surgery, where hemodynamic fluctuations can lead to myocardial ischemia and complications. Similar hemodynamic stability has been reported by Wallace et al., who emphasized that beta-blockers minimize hemodynamic variability during the perioperative period [12].

Our study also assessed postoperative recovery profiles. While not statistically significant, the trend toward shorter extubation times and higher early Aldrete scores in the beta-blocker group may reflect lower intraoperative drug accumulation, which facilitates faster emergence and respiratory function recovery. Previous studies have suggested that reduced anesthetic exposure may correlate with earlier postoperative recovery, particularly in high-risk cardiac surgical patients [13].

With regard to safety, our findings showed no significant increase in the incidence of bradycardia, hypotension, or reintubation in the beta-blocker group. This is consistent with large meta-analyses that conclude that beta-blocker therapy, when carefully monitored, does not pose significant intraoperative risk in cardiac surgery settings [14]. These results support the judicious use of beta-blockers as part of the preoperative optimization protocol, not only for their well-known cardioprotective effects but also for their favorable impact on anesthetic

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management. In high-volume surgical settings, this may also have pharmacoeconomic implications by reducing anesthetic drug consumption.

However, this study has some limitations. It was a single-center study with a modest sample size, and although the groups were well-matched, unmeasured confounders may have influenced results. Larger multicentric trials with uniform beta-blocker regimens and objective depth-of-anesthesia monitoring (e.g., BIS) could further validate these findings.

Conclusion

Preoperative administration of beta-blockers in patients undergoing elective cardiac surgery is associated with a significant reduction in the intraoperative requirements of anesthetic agents, particularly propofol, fentanyl, and sevoflurane. These patients also demonstrated improved hemodynamic stability and a trend toward faster recovery, with no increase in adverse events. Beta-blockers, when used appropriately, not only serve their primary cardioprotective role but also enhance anesthetic efficiency and safety. Incorporating betablockers into preoperative protocols may offer clinical and pharmacoeconomic advantages in cardiac surgical practice.

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