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ORIGINAL ARTICLE

Evaluation of the effectiveness of multimodal analgesia with low-dose opioids in post-operative pain management for CABG patients: A quasi-experimental study.

Gulrukh Begum[1], Laila Shaukat[2]

ABSTRACT… Objective: To evaluate effectiveness of multimodal analgesia (MMA) with low-dose opioids in reducing postoperative pain and the need for stronger opioids (nalbuphine) in patients undergoing coronary artery bypass grafting (CABG). **Study Design:** Quasi-experimental study. **Setting:** Department of Anesthesia Peshawar Institute of Cardiology, A Tertiary Care Hospital. **Period:** November 2024 to March 2025. **Methods:** Was conducted with 30 CABG patients receiving a standardized MMA regimen (acetaminophen, gabapentin, ketorolac, and low-dose morphine) for 72 hours postoperatively. Effectiveness was defined as maintaining Visual Analog Scale (VAS) scores ≤6/10 without nalbuphine escalation. Data on pain scores, opioid consumption, mobilization time, hospital stay, and complications were analyzed using SPSS v23. **Results:** MMA was effective in 83.3% of patients (n=25), while 16.7% (n=5) required nalbuphine. Median VAS pain scores decreased from 4 (IQR 3-5) at 6 hours to 0 (IQR 0-0) at 72 hours. Sedation was significantly associated with effectiveness (56% vs. 0%, p=0.022). No significant associations were found with demographic or surgical variables (all p>0.05). Postoperative complications included nausea (36.7%), vomiting (23.3%), and respiratory depression (16.7%). **Conclusion:** MMA with low-dose opioids effectively controlled post-CABG pain in most patients, reducing the need for stronger opioids. Sedation may serve as a clinical indicator of effective analgesia.

Key words: CABG, Multimodal Analgesia, Nalbuphine, Opioid Reduction, Postoperative Pain.

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INTRODUCTION

Sternotomy, sternal/rib retraction, pericardiotomy, internal mammary artery harvesting, saphenous vein harvesting, surgical manipulation of the parietal pleura, chest tube insertion, and other musculoskeletal damage during surgery are some of the causes of pain following cardiac surgery.

Opiate analgesics have historically been the mainstay of postoperative pain treatment following heart surgery. Opioids do, however, have certain unfavorable dose-related side effects, including as nausea, vomiting, constipation, dizziness, mental disorientation, and respiratory depression, which can significantly affect a patient's recuperation and postpone discharge.[1,2] Targeting multiple pain pathways at once is the goal of multimodal pain management in order to increase therapy effectiveness and recovery.[3] Additionally, recent data indicates that inadequate management of acute postoperative pain affects patients' well-being and raises their chance of developing chronic pain.[4] Evidence-based multimodal opiate-sparing analgesia following non-cardiac surgery has grown in popularity over the past 20 years.[5] Both the opiate-sparing effect and the achievement of more effective pain control through both central and peripheral anti-nociceptive mechanisms serve as justifications for the use of various analgesics.[1,6]

Following heart surgery, NSAIDs have shown opiate sparing effects in randomized trials.[7] However, NSAIDs have raised safety concerns for cardiac surgeons and anesthesiologists due to the possibility of bleeding, renal impairment, and an elevated risk of cardiovascular death.[8] Gamma-aminobutyric acid (GABA) analog gabapentin is mostly used to treat neuropathic pain and epilepsy, but it has also been employed in recent years as part of multimodal regimens following non-cardiac

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surgery.[9] Its effectiveness following heart surgery has been studied in recent trials, although the findings have been conflicting. In theory, gabapentin and NSAIDs should work together to produce synergistic analgesic and opiate-sparing effects; in fact, this combination has shown some promise in other surgical populations.[10,11]

The purpose of this study was to assess the effectiveness of a multimodal analgesic regimen that included low-dose opioids and NSAIDs, gabapentin, and paracetamol in lowering post-operative pain following CABG and the need to escalate opioids. According to our hypothesis, the multimodal regimen reduced side effects and had a better analgesic efficacy, as seen by an improved pain score.

To assess the effectiveness of multimodal analgesia (MMA) with low-dose opioids in reducing post-operative pain and opioid consumption, specifically evaluating the need for escalation to nalbuphine, which is the standard opioid protocol at the institution, in patients undergoing coronary artery bypass grafting (CABG) with sternotomy.

METHODS

This quasi-experimental single-arm study was conducted at Department of Anesthesia Peshawar Institute of Cardiology, a tertiary care hospital, from November 2024 to March 2025 following ethical approval from the institutional review board (Ref No. IRC/25/215) (22-07-2025). A convenience sample of 30 adult patients (aged ≥18 years) undergoing elective CABG via sternotomy were enrolled after obtaining informed consent. Exclusion criteria included chronic pain or opioid dependence, severe renal/hepatic impairment, and allergies to any components of the MMA protocol.

Postoperatively, patients received a standardized MMA regimen consisting of acetaminophen (1 g IV every 6 hours), gabapentin (300 mg orally every 8 hours), ketorolac (15 mg IV every 6 hours), and low-dose morphine (0.05 mg/kg IV) for breakthrough pain over 72 hours. MMA effectiveness was defined as maintaining pain at VAS ≤6/10 without requiring escalation to nalbuphine; VAS ≥7/10 necessitating nalbuphine or stronger opioids classified the regimen as ineffective. Data on demographics (age, gender, BMI), clinical characteristics (comorbidities, surgical details), and outcomes (VAS scores at 6, 12, 24, 48, and 72 hours, nalbuphine escalation, time to first mobilization, hospital stay, and adverse effects—nausea, vomiting, respiratory depression, dizziness, sedation) were collected via standardized questionnaires and medical records.

Statistical analysis was performed using SPSS v23. Continuous variables (age, BMI, pain scores, mobilization time, hospital stay) were reported as mean ± SD or median (IQR), while categorical variables (gender, MMA effectiveness, adverse effects) were presented as frequencies (%). The primary outcome (MMA effectiveness) was stratified by patient and surgical variables, with associations assessed using Chi-square or Fisher's exact tests (significance: $p \leq 0.05$). Normality was evaluated via Shapiro-Wilk/Kolmogorov-Smirnov tests.

RESULTS

The study included 30 patients with a mean age of 59.9 ± 10.6 years and BMI of 30.7 ± 2.7. LVEF averaged 54.2 ± 5.7%, while the number of involved vessels was median 3 (IQR 2-3). Surgical duration averaged 284.7 ± 70.4 minutes with cross-clamp time of 78.6 ± 32.2 minutes. Postoperative pain scores (non-normal) were: 6hrs - median 4 (IQR 3-5), 12hrs - 3 (2-4), 24hrs - 2 (0-2), 48hrs - 2 (2-2), and 72hrs - 0 (0-0). Total opioid consumption was highly skewed (median 40, IQR 28-400). Mobilization time was median 13 days (IQR 7-27) and hospital stay median 5 days (IQR 3-7). The data showed normal distributions for age, BMI, and LVEF, while pain scores and opioid use were non-normally distributed.

The study included 17 (56.7%) males and 13 (43.3%) females. Cardiopulmonary bypass (CPB) was used in 28 (93.3%) cases. Postoperative complications included nausea 11 (36.7%), vomiting 7 (23.3%), sedation 14 (46.7%), respiratory depression 5 (16.7%), and dizziness 5 (16.7%). (Table-I)

The effectiveness of MMA was assessed in 30 patients, with 25 (83.3%) achieving adequate pain control and 5 (16.7%) reporting insufficient relief (Figure-1).

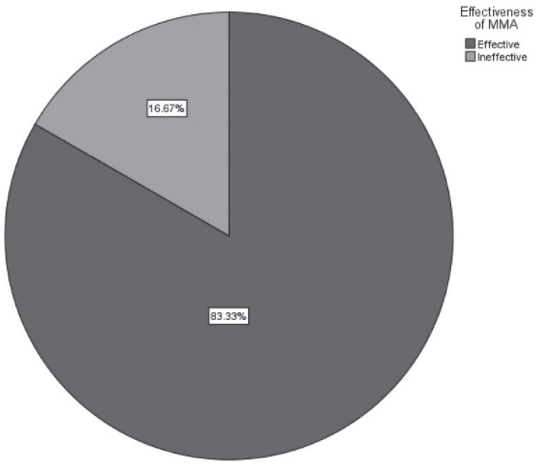
TABLE-I

Demographic and clinical characteristics (n=30)

Variable	Category	Frequency (%)
Gender	Male	17 (56.7%)
	Female	13 (43.3%)
CPB Use	Yes	28 (93.3%)
	No	2 (6.7%)
Nausea	Yes	11 (36.7%)
	No	19 (63.3%)
Vomiting	Yes	7 (23.3%)
	No	23 (76.7%)
Respiratory Depression	Yes	5 (16.7%)
	No	25 (83.3%)
Dizziness	Yes	5 (16.7%)
	No	25 (83.3%)
Sedation	Yes	14 (46.7%)
	No	16 (53.3%)

FIGURE-1

Effectiveness of MMA (Multi Modal Analgesia)



Most effective cases occurred in patients >40 years (96.0% vs 100% ineffective, p=0.649), males (56.0% vs 60.0%, p=0.869), and CPB users (92.0% vs 100%, p=0.513). Obese patients showed similar effectiveness rates (68.0% effective vs 60.0% ineffective, p=0.729). No significant associations were found for LVEF categories (96.0% >40% in both groups, p=0.649), surgery duration (72.0% >4hrs effective vs 60.0% ineffective, p=0.593), early mobilization (96.0% <24hrs in both, p=0.649), or hospital stay (80.0% <5 days effective vs 60.0% ineffective, p=0.334). (Table-II)

Postoperative complications analysis revealed sedation was significantly associated with effectiveness (56.0% effective cases had sedation vs 0% ineffective, p=0.022). Nausea (32.0% vs 60.0%, p=0.236), vomiting (20.0% vs 40.0%, p=0.334), and dizziness (12.0% vs 40.0%, p=0.125) were more common in ineffective cases but not statistically significant. Respiratory depression showed no difference (20.0% effective vs 0% ineffective, p=0.273). All ineffective cases (100%) occurred in non-sedated patients. (Table-III)

DISCUSSION

The present study demonstrated that a multimodal analgesia (MMA) protocol incorporating low-dose opioids was effective in controlling postoperative pain for 83.3% of CABG patients, significantly reducing the need for escalation to stronger opioids like nalbuphine. These findings align with several studies investigating MMA in cardiac surgery populations.[3,12] The progressive reduction in median VAS scores observed in our study (from 4 at 6 hours to 0 at 72 hours) mirrors the pain trajectory reported by Barr et al., suggesting consistent analgesic effectiveness across the critical postoperative period.[13]

The significant association between sedation and MMA effectiveness (p=0.022) represents a notable finding, as all ineffective cases occurred in non-sedated patients. This observation parallels work by Jannati M et al. that identified sedation levels as potential markers of adequate analgesia in opioid-sparing protocols.[17]

Our results showing no demographic or surgical predictors of MMA effectiveness contrast with some previous literature. While Fernandez RM et al.[16], reports that younger age and female gender as predictors of better MMA response, we found no significant associations with age (p=0.649), gender (p=0.869), or surgical duration (p=0.593).

Table-II

Association between patient characteristics and MMA effectiveness

Variable	Category	Effective (n=25)	Ineffective (n=5)	P-Value
Age Categories	<40 years	1 (4.0%)	0 (0.0%)	0.649
	>40 years	24 (96.0%)	5 (100.0%)	
Gender	Male	14 (56.0%)	3 (60.0%)	0.869
	Female	11 (44.0%)	2 (40.0%)	
Use of CPB	Yes	23 (92.0%)	5 (100.0%)	0.513
	No	2 (8.0%)	0 (0.0%)	
BMI Categories	Overweight	8 (32.0%)	2 (40.0%)	0.729
	Obese	17 (68.0%)	3 (60.0%)	
LVEF Categories	<40%	1 (4.0%)	0 (0.0%)	0.649
	>40%	24 (96.0%)	5 (100.0%)	
Surgery Duration	<4 hrs	7 (28.0%)	2 (40.0%)	0.593
	>4hrs	18 (72.0%)	3 (60.0%)	
First Mobilization	<24hrs	24 (96.0%)	5 (100.0%)	0.649
	>24hrs	1 (4.0%)	0 (0.0%)	
Hospital Stay	<5 days	20 (80.0%)	3 (60.0%)	0.334
	>5 days	5 (20.0%)	2 (40.0%)	

TABLE-III

Association between postoperative complications and MMA effectiveness (n=30)

Complication	Group	Effective n=25 n(%)	Ineffective n=5 n(%)	P-Value
Nausea	Yes	8 (32.0%)	3 (60.0%)	0.236
	No	17 (68.0%)	2 (40.0%)	
Vomiting	Yes	5 (20.0%)	2 (40.0%)	0.334
	No	20 (80.0%)	3 (60.0%)	
Respiratory Depression	Yes	5 (20.0%)	0 (0.0%)	0.273
	No	20 (80.0%)	5 (100.0%)	
Dizziness	Yes	3 (12.0%)	2 (40.0%)	0.125
	No	22 (88.0%)	3 (60.0%)	
Sedation	Yes	14 (56.0%)	0 (0.0%)	0.022*
	No	11 (44.0%)	5 (100.0%)	

These discrepancies may stem from variations in MMA protocols or patient populations. The lack of association with CPB use (p=0.513) contradicts findings by Van et al., who reported better pain control in off-pump CABG patients, suggesting our MMA protocol may mitigate the inflammatory effects of CPB.[14]

The 16.7% MMA failure rate in our study merits consideration. While lower than the 25-30% failure rates reported by Jin L et al in his trial.[17] The higher (though non-significant) rates of nausea (60% vs 32%) and vomiting (40% vs 20%) in ineffective cases echo observations by Cozowicz et al., suggesting inadequate pain control may contribute to these complications.[3]

Several limitations should be acknowledged. The single-arm design precludes direct comparison to conventional analgesia, and the modest sample size may have limited statistical power for some analyses. Additionally, the lack of standardized sedation scoring represents a potential measurement bias. Future studies incorporating randomized controlled designs, larger samples, and quantitative sedation assessment would strengthen these findings.

CONCLUSION

MMA with low-dose opioids effectively controlled post-CABG pain in most patients, reducing the need for stronger opioids. Sedation may serve as a clinical indicator of effective analgesia.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Gulrukh Begum:** Study design, sample collection, data analysis, writing.
2	**Laila Shaukat:** Interpretation of data, critical revision, writing.