Albanian Journal of Trauma and Emergency Surgery (2025) 9/1:1645-1649
DOI: **https://doi.org/10.32391/ajtes.v9i1.444**

ORIGINAL ARTICLES

Diagnosis and Treatment of Postoperative Myocardial Infarction: A Retrospective Cohort Study on 600 Cardiac Surgery Patients

Saimir Kuci[1*], Marsela Goga[1], Alfred Ibrahimi[1], Ervin Bejko[1], Stavri Llazo[1], Jonela Burimi[1], Esmerilda Bulku[1], Andi Kacani[2], Ermal Likaj[2], Ali Refatllari[2], Selman Dumani[2], Klodian Krakulli[2], Arber Aliu[2], Fjorba Mana[2], Devis Pellumbi[2], Aferdita Veseli[2], Edlira Rruci[2], Laureta Dibra[2], Arben Baboci[2], Edvin Prifti[2], Altin Veshti[2]

Received: 25 December 2024 / *Accepted:* 10 January 2025 / *Published online:* 20 January 2025
This article is published with open access at **https://journal.astes.org.al**

Abstract

Introduction: Postoperative myocardial infarction (PMI) is a severe complication after cardiac surgery, significantly impacting patient outcomes. Acute PMI after cardiac surgery is an infrequent event that can evolve rapidly and become a potentially life-threatening complication. Multiple factors are associated with acute PMI after cardiac surgery and may vary by the type of surgical procedure performed. Although the criteria defining nonprocedural myocardial ischemia are well established, there are no universally accepted criteria for diagnosing acute PMI. This retrospective study analyzed 600 patients who underwent cardiac surgery at a single center over one year. The incidence, diagnosis, and management of PMI were evaluated, focusing on diagnostic methods, therapeutic interventions, and the role of intra-aortic balloon pumps (IABPs). Our findings provide insights into the anesthesiologist's role in identifying and managing PMI, highlighting strategies to reduce morbidity and mortality in this high-risk population.

Conclusion: Early detection and tailored management of PMI are vital to reducing complications. Anesthesiologists and intensive care teams are key in optimizing outcomes through advanced support measures like intra-aortic balloon pumps. These findings, which provide practical insights to enhance perioperative care, empower us to manage this high-risk population better.

Keywords: PMI, cardiac surgery, IABP, perioperative care, anesthesiology, morbidity, mortality.

Introduction

Acute postoperative myocardial ischemia (PMI) after cardiac surgery is an infrequent event but can evolve rapidly and become a potentially severe complication. The diagnosis of acute PMI (defined here as myocardial ischemia occurring any time from arrival in the intensive care unit to discharge) is more complex than the diagnosis of ischemia in the non-postoperative setting because of potential confounders related to the recent surgery and postoperative treatments. PMI is a serious complication following cardiac surgery, with reported incidences ranging from 5% to 15% depending on patient risk profiles and surgical complexity [1, 2]. Prompt diagnosis and effective management are crucial for improving outcomes.

The anesthesiologist's role is pivotal, as perioperative monitoring and decision-making can help detect PMI early and guide interventions. This study aims to analyze the incidence of PMI in 600 cardiac surgery patients, focusing on diagnostic criteria, treatment modalities, and outcomes, including using IABPs. Your role as an anesthesiologist is crucial in this process, and your expertise is invaluable in optimizing patient outcomes.

Original article, no submission or publication in advance or in parallel

* ***Corresponding author:***
Asc.Prof. Saimir Kuci, MD, PhD
saimirkuci@gmail.com

1 Anesthesia & ICU Service at University Hospital Center "Mother Teresa" Tirana, ALBANIA
2 Cardiac Surgery Service at University Hospital Center "Mother Teresa" Tirana, ALBANIA

Materials and Methods

Our study design is a retrospective cohort study. The population included in this study is 600 adult patients who underwent cardiac surgery between January and December 2023 at a single tertiary care center, University Hospital Center “Mother Teresa,” in Tirana, Albania. We used the inclusion criteria for patients undergoing elective or emergency coronary artery bypass grafting (CABG), valve surgeries, or combined procedures.

Patients with preoperative myocardial infarction (MI) within 48 hours of surgery or incomplete postoperative data in the last year, 2023, were excluded from the study. The data collected were patient demographics (age, sex, comorbidities) and surgery type (CABG, valve surgery, combined). We studied diagnostic methods for PMI (ECG, biomarkers, echocardiography), management strategies (medical therapy, IABP usage), and outcomes (ICU stay, mortality).

Acute PMI after cardiac surgery is usually asymptomatic because patients are often incapable of reporting classic ischemic indicators in the early period due to the effects of postoperative pain management (anesthesia and analgesia) and the masking effect of symptoms related to surgery (pain, nausea, fatigue). Furthermore, acute PMI is difficult to distinguish from myocardial infarction. In the Fourth Universal Definition of Myocardial Infarction, there is no consensus on the troponin cutoff points that differentiate cardiac procedural myocardial ischemia from myocardial infarction.

PMI was diagnosed based on the Fourth Universal Definition of Myocardial Infarction, requiring a significant elevation in cardiac troponin (≥10 times the 99th percentile upper reference limit) with supporting evidence of myocardial ischemia (ECG changes, new wall motion abnormalities, or angiographic findings)[3]

Results

Patient Demographics: The study included 600 patients, with a mean age of 63 years (range 45–82). Of these, 410 were male (68.3%), and 190 were female (31.7%).

Table 1 shows comorbidities such as Hypertension (65%), diabetes (50%), and hyperlipidemia (48%). The surgical procedures included CABG (360 patients (60%), valve surgery (180 patients (30%), and combined procedures (60 patients (10%).

This study’s total number of PMI cases was 54 patients (9%). The CABG group had 30 360 cases (8.3%), the valve surgery group had 18 180 cases (10%), and the combined procedures group had 6 60 cases (10%).

Graph 4 describes the diagnostic methods used. Elevated cardiac troponins: all 54 cases (100%). *ECG changes:* 40 cases (74%), including ST-segment elevation (18%), ST-segment depression (38%), and new-onset left bundle branch block (18%). Echocardiographic findings (new wall motion abnormalities): 32 cases (59%), as shown in Table 2.

Parameter PMI Group (n=54) Non-PMI Group (n=546)

Parameter	PMI Group (n=54)	Non-PMI Group (n=546)	Total Cohort (n=600)
Mean age (years)	66 ± 10	63 ± 12	63 ± 12
Male (%)	70.4%	68.1%	68.3%
Hypertension (%)	72.2%	64.6%	65.0%
Diabetes (%)	57.4%	49.6%	50.0%
Surgical Type: CABG (%)	55.6%	61.2%	60.0%
Surgical Type: Valve (%)	33.3%	29.7%	30.0%
Combined Procedures (%)	11.1%	9.1%	10.0%

Table 1: Patient Demographics and Surgical Distribution

Diagnostic Modality	PMI Cases (n=54)	Percentage (%)
Elevated Troponins	54	100%
ECG Changes	40	74%
ST-Segment Elevation	10	18%
ST-Segment Depression	21	38%
New LBBB	10	18%
Echocardiography (WMA)	32	59%

Table 2: Diagnostic Methods for PMI

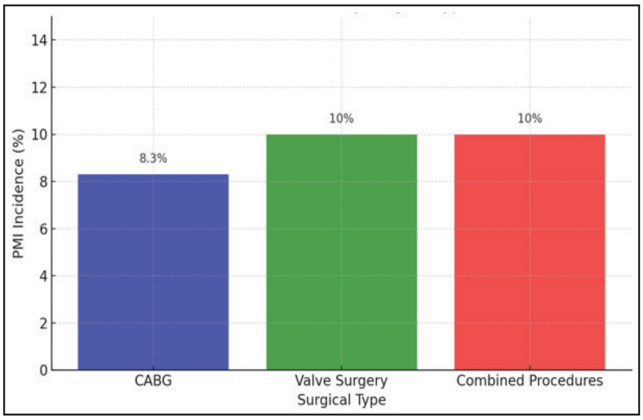
Management of PMI: 35 patients (65%) were managed with medical treatment alone. Two patients (4%) underwent coronary artery bypass re-intervention. IABP was placed in 15 patients (28%) of PMI cases. Graph 1 shows the incidence of PMI according to the surgical type performed.

IABP Usage in the entire Cohort: Total IABP usage: 30/600 patients (5%). 15/54 (28%) of PMI cases required IABP as treatment according to the indications as seen in Graph 2: Cardiogenic shock (67%) and refractory ischemia (33%).

Postoperative Outcomes: We used ICU stay as the leading indicator of postoperative outcomes in our patients and compared the 30-day mortality in each group, as seen in Graph 3.

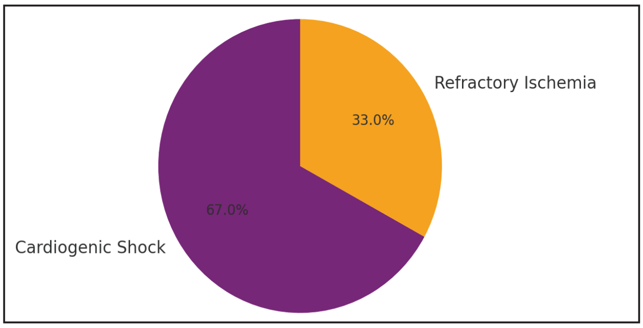
The ICU stay was significantly more extended in the PMI group (>3 days): 38 PMI patients (70%) vs. 120 non-PMI patients (22%). Graph 5 shows the duration of the ICU stay in the two groups.

30-day mortality was also significantly higher in the PMI group, 8/54 (14.8%), and in the non-PMI group, 10/546 (1.8%).



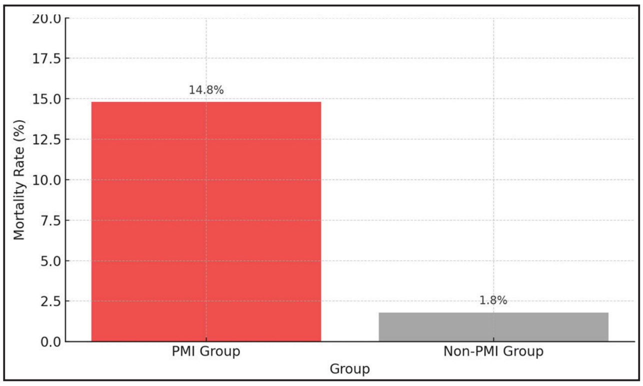
Graph 1: Incidence of PMI by Surgical Type

A bar chart compares PMI incidence across CABG, valve surgeries, and combined procedures.



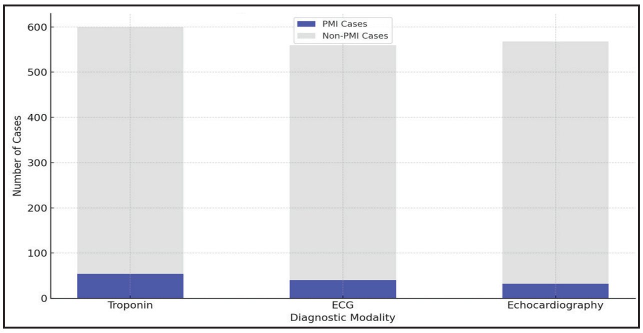
Graph 2: IABP Usage and Outcomes

Here is a pie chart showing the indications for IABP in PMI cases: cardiogenic shock (67%) and refractory ischemia (33%).

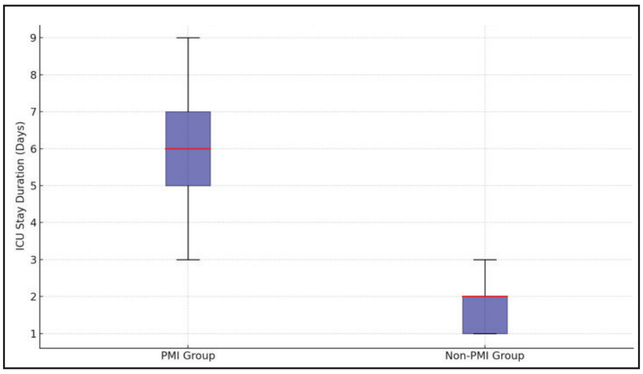


Graph 3: 30-Day Mortality Rates

A line graph comparing the mortality rates between PMI and non-PMI groups.



Graph 4: Distribution of Diagnostic Modalities



Graph 5: ICU Stay Duration

Discussion

PMI Incidence and Risk Factors: This study's observed 9% incidence of PMI aligns with the expected range reported in the literature (5–15%)[1, 2]. This variability can be attributed to differences in patient demographics, comorbidities, and surgical complexities across studies. In recent studies, the incidence of myocardial infarction has been reported to range from 0.3% to 9.8% after isolated CABG and from 0.7% to 11.8% after concomitant valvular surgery. The slightly higher PMI rates in valve surgeries (10%) and combined procedures (10%) compared to CABG (8.3%) underscore the impact of prolonged cardiopulmonary bypass (CPB) times and heightened myocardial vulnerability during these operations [4, 5].

Many factors may lead to acute PMI after cardiac surgery, and they differ by the type of surgical procedure performed, as seen in Figure 1.

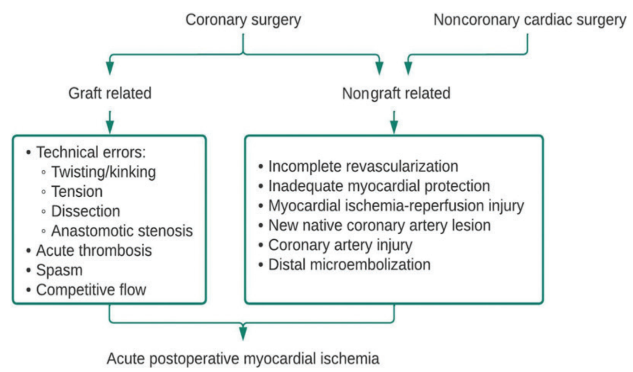


Figure 1. Mechanisms of postoperative myocardial ischemia after cardiac surgery.

Patients with comorbidities like diabetes (50%) and Hypertension (65%) demonstrated higher PMI risks, consistent with the role of systemic inflammation and microvascular dysfunction in ischemia [3, 6]. Identifying such risk factors preoperatively can guide preventive strategies, including enhanced myocardial protection techniques.

Diagnostic Challenges: Clinical diagnosis of acute PMI in patients undergoing cardiac surgery is challenging. The reasons for this are multifactorial: Sedation may mask ischemic symptoms; there is distracting pain from either sternotomy or thoracotomy incisions; and hemodynamics after extracorporeal circulation frequently require support with inotropic and vasoconstrictor infusions even in patients without myocardial injury. Diagnosis may be further confounded by other early postoperative complications such as tamponade due to pericardial effusions compromising myocardial function. In a patient with failure to wean from cardiopulmonary bypass, new or unexpectedly high requirements for vasoactive support or mechanical circulatory support (MCS), postcardiotomy shock, low cardiac output syndrome, or chest pain out of proportion to usual incisional pain, further evaluation for acute PMI is warranted. This study reaffirms the diagnostic utility of cardiac troponins, ECG, and echocardiography in detecting PMI. The universal troponin elevation in PMI patients emphasizes its role as a sensitive biomarker; however, its specificity remains limited due to potential postoperative elevations unrelated to ischemia [7].

Hence, integrating biomarkers with imaging modalities such as echocardiography and advanced ECG analysis enhances diagnostic accuracy. While echocardiography identified wall motion abnormalities in 59% of PMI cases, its limited sensitivity highlights the need for real-time perioperative imaging tools like transesophageal echocardiography (TEE). Future research could explore combining TEE with myocardial strain analysis to improve early ischemia detection.

Therapeutic Strategies: The predominance of medical management (65%) in PMI cases reflects the perioperative bleeding risks associated with interventions like PCI or repeat CABG [7]. PCI was not performed in any of the PMI cases because of their severity and the difficulty of transporting them to the hemodynamic operating room. However, careful multidisciplinary planning is essential.

The 28% utilization of IABP in PMI underscores its importance in managing cardiogenic shock and refractory ischemia [9, 10]. Despite controversies surrounding IABP efficacy, its mechanical circulatory support remains vital in hemodynamic stabilization during critical postoperative periods. Future studies could explore expanding the use of advanced mechanical support devices, such as extracorporeal membrane oxygenation (ECMO), for severe cases.

Outcome Analysis: The study's findings on ICU stays and mortality rates reveal the profound impact of PMI on postoperative recovery. Patients with PMI had a nearly eightfold increase in 30-day mortality compared to non-PMI patients (14.8% vs. 1.8%), emphasizing the urgency of preventive measures. Targeted perioperative optimization, such as beta-blockade and myocardial conditioning, could help mitigate such adverse outcomes.

Conclusion

PMI occurred in 9% of patients undergoing cardiac surgery in this cohort study, with significant impacts on morbidity and mortality. Troponin surveillance, multidisciplinary management, and timely interventions, including IABP placement, are essential to improve outcomes. Anesthesiologists play a crucial role in the early diagnosis and hemodynamic stabilization of PMI, emphasizing the need for vigilant perioperative care.

COI Statement: This paper has yet to be submitted in parallel, presented fully or partially at a meeting, podium, or congress, published, or submitted for consideration beforehand.

This research received no specific funding from public, commercial, or non-profit sectors. The authors declare that they, their relatives, or next of kin have no financial relationships with external companies that could be considered relevant or minor.

Disclosure: The authors declared no conflict of interest. No funding was received for this study.

Abbreviations

PMI - Postoperative myocardial infarction; IABP - Intra-Aortic Balloon Pump; MI - Myocardial Infarction; CABG - Coronary Artery Bypass Grafting; ICU – Intensive Care Unit; CPB - Cardiopulmonary Bypass; TEE - Transesophageal Echocardiography; PCI - Percutaneous Coronary Intervention;

References

1. Landesberg, G., Beattie, W. S., Mosseri, M., et al. (2009). Perioperative myocardial infarction. *Circulation,* 119(22), 2936–2944. https://doi.org/10.1161/CIRCULATIONAHA.108.828228
2. Puelacher, C., Gualandro, D. M., Glarner, N., & BASEL-PMI Investigators (2023). Long-term outcomes of perioperative myocardial infarction/injury after noncardiac surgery. *European Heart Journal,* 44(19), 1690–1701. https://doi.org/10.1093/eurheartj/ehac798
3. Thygesen, K., Alpert, J. S., Jaffe, A. S., & Executive Group on behalf of the Joint European Society of Cardiology (ESC)/American College of Cardiology (ACC)/American Heart Association (AHA)/World Heart Federation (WHF) Task Force for the Universal Definition of Myocardial

Infarction (2018). Fourth Universal Definition of Myocardial Infarction (2018). *Journal of the American College of Cardiology,* 72(18), 2231–2264. https://doi.org/10.1016/j.jacc.2018.08.1038

4. Yang, J. N., Zhang, X. M., Ma, L. Y., et al. (2021). Effect of cardiopulmonary bypass reoxygenation on myocardial dysfunction following pediatric tetralogy of Fallot repair. *BMC Cardiovascular Disorders,* 21(1), 210. https://doi.org/10.1186/s12872-021-02033-2
5. Beattie, W. S., Wijeysundera, D. N., Karkouti, K., et al. (2010). Acute surgical anemia influences the cardioprotective effects of beta-blockade: a single-center, propensity-matched cohort study. *Anesthesiology*, 112(1), 25–33. https://doi.org/10.1097/ALN.0b013e3181c5dd81
6. Devereaux, P. J., Lamy, A., Chan, M. T. V., & VISION Cardiac Surgery Investigators (2022). High-Sensitivity Troponin I after Cardiac Surgery and 30-Day Mortality. *The New England journal of medicine,* 386(9), 827–836. https://doi.org/10.1056/NEJMoa2000803
7. Condello, I., Lorusso, R., Santarpino, G., et al. (2022). Perioperative incidence of ECMO and IABP on 5901 mitral valve surgery procedures. *Journal of Cardiothoracic Surgery,* 17(1), 38. https://doi.org/10.1186/s13019-022-01790-1
8. Ibanez, B., James, S., Agewall, S., & ESC Scientific Document Group (2018). 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). *European Heart Journal,* 39(2), 119–177. https://doi.org/10.1093/eurheartj/ehx393
9. Thiele, H., Zeymer, U., Neumann, F. J., & IABP-SHOCK II Trial Investigators (2012). Intraaortic balloon support for myocardial infarction with cardiogenic shock. *The New England journal of medicine,* 367(14), 1287–1296. https://doi.org/10.1056/NEJMoa1208410
10. Sessler, D. I., Meyhoff, C. S., Zimmerman, N. M., et al. (2018). Period-dependent Associations between Hypotension during and for Four Days after Noncardiac Surgery and a Composite of Myocardial Infarction and Death: A Substudy of the POISE-2 Trial. *Anesthesiology*, 128(2), 317–327. https://doi.org/10.1097/ALN.0000000000001985