Frequency of intra-aortic balloon pump insertion in coronary artery bypass grafting

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ABSTRACT:

Objective: To determine the frequency of intra-aortic balloon pump insertion in coronary artery bypass grafting.

Methodology: This Quasi-Experimental descriptive observational study conducted after enrolling 118 patients of either gender, aged 25-70 years during April 2025 to Oct 2025 at Cardiac Surgery Department, Peshawar Institute of Cardiology undergoing CABG, after diagnosis of coronary artery disease, defined by chest pain (VAS>3) and dyspnoea with confirmatory ECG findings. Patients with past history of cardiac surgery, end-stage renal disease, severe arrhythmias, pregnancy, neurological impairment, and chronic pulmonary disease were excluded. CABG was performed in all patients. SPSS 25 was used. Frequency of intra-aortic balloon pump was determined. Mann-Whitney and Fisher's exact tests were used, keeping p value significant at ≤ 0.05.

Results: Median age of 118 patients was 60 (52.75-65.25) years, with majority patients (n=90, 76.3%) being male. The median ejection fraction was 57 (46-59) %. The frequency of IABP insertion among CABG patients was 2.5% (n=3) (95% CI: 0.005 to 0.073). Ejection fraction was significantly lower in patients of IABP.

Conclusion: The observed correlation between IABP use and reduced ejection fraction underscores its role in managing patients with impaired ventricular function. These findings reinforce the value of IABP as a strategic perioperative intervention to optimize hemodynamic support in high-risk cardiac surgery.

Keywords: Intra-aortic balloon pump, coronary artery bypass grafting, cardiac surgery, ventricular dysfunction, ejection fraction

Cite as: Khan AR, Nasir A. Frequency of intra-aortic balloon pump insertion in coronary artery bypass grafting. J Muhammad Med Coll. 17(1) May-Oct 2026

Introduction:

Coronary artery bypass grafting (CABG) is considered to be a cornerstone surgical procedure among patients with advanced coronary artery disease (CAD), predominantly in multivessel disease cases, not suitable for percutaneous revascularization. Although progressions in myocardial protection and cardiopulmonary bypass management, a considerable number of cases continue to face the perioperative low cardiac output syndrome and hemodynamic instability. However, in the context of Intra-aortic balloon pump (IABP) which is raised as commonly used temporary mechanical circulatory support method, anticipated for the augmenting coronary perfusion and decrease the left ventricular afterload offering the hemodynamic stabilization within the high-risk CABG individuals.[1-4] In resource-limited settings, outcomes associated with intra-aortic balloon pump (IABP) use during coronary artery bypass grafting have been frequently reported, consistently contributing valuable insights. A study found that IABP was inserted in the 3.9% of CABG patients experiencing the serious left ventricular dysfunction signifying its importance within the group of high-risk individuals.[5]

IABP was presented for the support patients having the perioperative cardiogenic shock, however tis utilization has stretched across the prophylactic alongside the perioperative backgrounds among the patients having decreased left ventricular ejection fraction (LVEF).[6] The optimal timing for IABP insertion continue to be the subjects of discussion. Factors including the preoperative LVEF and trouble weaning from CPB are generally quoted signs, however the standardized criteria are missing. Numerous investigations recorded that prophylactic IABP placement within the patients with compromised ventricular function as helpful whereas some highlighted that inappropriate use may prolong the time of ventilation and ICU stays in the absence of clear survival benefit.[6-9] Studies has investigated the benefits of IABP in CABG along with its impact on morbidity and mortality. An investigation has suggested that preoperative IABP may decrease the mortality and major unfavorable cardiac events within the selected high-risk patients. Perioperative IABP utilization is linked to better short-term hemodynamics, however its impact on the long-term consequences remains to be explored.[10-12]

Patients with severe left ventricular dysfunction, myocardial ischemia are susceptible to compromised myocardial perfusion after the CABG that sometime leads adverse outcomes. The IABP has the potential to improve the coronary blood flow and enhance the overall cardiac output thus contributing to temporary circulatory support throughput the critical perioperative periods. Existing literature indicates conflicting evidences; therefore, this study is warranted to systematically assess clinical justification of IABP insertion in CABG patients marking to generate context specific evidence that may assists in decision making and improve surgical outcomes.

Objective:

The study aims to determine the frequency of IABP insertion in the patients treated with CABG.

Methodology:

This study was conducted in the Cardiac Surgery Department, Peshawar Institute of Cardiology, after taking ethical

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Received: May 2026, Revised: August 2026
Accepted: September 2026

approval from the hospital's IRB (Ref# IRC/25/145). One hundred eighteen patients were selected for this study, this sample was selected on the basis of previous frequency of IABP among CABG patients 3.9%,5 margin of error 3.5% and confidence level 95% using the formula n = Z2 P (1-P) / d 2. Eligible patients were aged between 25 to 70 years, of either gender, presenting with coronary artery disease, undergoing coronary artery bypass grafting. Coronary artery disease was defined as patients presenting with Chest pain (VAS>3), and dyspnea. Diagnosis was made by using the Electrocardiogram (ECG) observing any two of the following features, ST-segment Depression, ST-segment Elevation, presence of T-wave Inversions, and Q Waves. Coronary artery bypass grafting was defined as the surgical procedure used to treat severe CAD by creating the new pathways (bypasses) for blood to flow around the blocked or narrowed sections of the coronary arteries. Patients having history of previous cardiac surgery, end-stage renal disease, patients with severe or uncontrolled arrhythmias, pregnant patients, patients with seizures or neurological impairment, and patients with chronic obstructive pulmonary disease and asthma were excluded.

All the patients were briefed about the objective and benefits of the study; all patients provided their consent. Baseline demographics like age, gender, BMI, socio economic status, residence area, education status, and employment status were recorded. History of smoking, diabetes, and hypertension was documented as well. Patients with CAD undergoing coronary artery bypass grafting were evaluated for intra-aortic balloon pump insertion, which was the advancement of IABP catheter, over the guide-wire with the balloon at its distal end. The balloon was typically positioned 2-3 cm below the left subclavian artery or at the level of the renal arteries. Confirmation of balloon position was made by using the Fluoroscopy/X-ray within the descending aorta. A comprehensive evaluation was conducted under the supervision of a consultant having at least 5 years of experience following fellowship. A structured proforma was utilized to document the details of each patient.

SPSS 25 was used to analyze the data. Normality was checked through Shapiro-Wilk test and quantitative variables were found not normal. Median IQR were calculated for quantitative variables such as age, BMI, duration of hospital stay and ejection fraction. Frequencies and percentages were used calculated for categorical variables such as intra-aortic balloon pump insertion, gender, diabetes, hypertension, smoking, socio economic status, residence area, education status, and employment status. Age, ejection fraction, BMI and duration of hospital stay were compared between IABP and non-IABP groups using Mann-Whitney test, while for assessing the association of IABP with gender, diabetes, hypertension and smoking, Fisher's exact test was used. p value ≤ 0.05 was considered significant.

Results:

The present study had 118 patients, with median age 60 (52.75-65.25) years. Their median body mass index (BMI) was 36.78 (31.83-38.58) kg/m². Median duration of hospital stay was 5 (5-6) days. The median monthly income was 71000 (40000-85000) rupees. Median ejection fraction was 57 (46-59) % (Table I). Majority of the cohort were male 90 (76.3%) patients, while females were 28 (23.7%) (Table II). Table III presents the comorbidities present in the study cohort. The frequency of intra-aortic balloon pump (IABP) insertion in the present study was 3 (2.5%) (95% CI: 0.005 to 0.073) (Figure 1).

Table No 1: Analysis of numerical variables in the study.

Variables	Median (IQR)
Age (Years)	60 (52.75-65.25)
BMI (Kg/m^2)	36.78 (31.83-38.58)
Duration of hospital stay (Days)	5 (5-6)
Monthly income (Rs)	71000 (40000-85000)
Ejection fraction (%)	57 (46-59)

Table No 2: Demographic

Demographics		n	%
Gender	Male	90	76.3%
	Female	28	23.7%
Residence	Urban	53	44.9%
	Rural	65	55.1%
Education status	Literate	74	62.7%
	Illiterate	44	37.3%
Employment status	On Service	63	53.4%
	Retired	55	46.6%
Socioeconomic status	High	5	4.2%
	Low	67	56.8%
	Medium	46	39.0%

Table No 3: Comorbidities

Comorbidities		n	%
Smoking	Yes	18	15.3%
	No	100	84.7%
Diabetes	Yes	56	47.5%
	No	62	52.5%
Hypertension	Yes	26	22.0%
	No	92	78.0%

Table No 4: Comparison of age, duration of hospital, BMI and ejection fraction between patients with IABP vs non-IABP

Parameters	N	Median	IQR	p value
Age (Years)	118	60	52.75-65.25	0.190
BMI (Kg/m2)	118	36.73	31.83-38.58	0.810
Duration of hospital stay (Days)	118	5	6-5	0.531
Ejection fraction (%)	118	57	46-59	0.027
Mann-Whitney test applied				

Table No 5: Association of gender and comorbidities with Intra-aortic balloon pump insertion.

		Intra-aortic balloon pump insertion				p value
		Yes		No		
		n	%	n	%	
Gender	Male	3	100.0%	87	75.7%	1.00
	Female	0	0.0%	28	24.3%	
Smoking	Yes	1	33.3%	17	14.8%	0.394
	No	2	66.7%	98	85.2%	
Diabetes	Yes	2	66.7%	54	47.0%	0.603
	No	1	33.3%	61	53.0%	
Hypertension	Yes	0	0.0%	26	22.6%	1.00
	No	3	100.0%	89	77.4%	
Fisher's exact test used						

Discussion:

The present study analyzed the frequency of intra-aortic balloon pump (IABP) insertion in patients undergoing CABG. The cohort, with an age range of 52.75-65.25 years and predominantly male representation, aligns with several studies reporting a majority of male patients undergoing coronary artery bypass grafting (CABG).[3,12] This male preponderance is a consistent feature in cardiac surgical populations. In the present study, the frequency of IABP insertion was significantly low 2.5% (n = 3). Ahmad *et al*.[5] reported 3.9% frequency of IABP insertion, while Bahar *et al*.[13] reported the frequency of IABP in their study 3.1%. In contrast, Kamal et al.[12] reported 9.7%, while Khan et al.[14] observed that among 110 patients with left ventricular ejection fraction (LVEF) below 30%, thirty required intra-aortic balloon pump (IABP) insertion. Parissis et al.[15] documented a rate of 7%. This discrepancy likely reflects variations in patient risk profiles and institutional thresholds for intra-aortic balloon pump (IABP) utilization. Comparative analysis in the present study revealed that patients requiring intra-aortic balloon pump (IABP) support had significantly lower ejection fractions compared to those who did not. This finding reinforces the well-established association between reduced ventricular function and the need for IABP, a relationship consistently reported across multiple studies.[3,14-17] Escutia-Cuevas et al.[18] found that preoperative IABP was beneficial in patients with left ventricular ejection fraction (LVEF) >35%, but not in those presented with more severe dysfunction.

The present study did not identify significant differences in age, body mass index (BMI), or duration of hospital stay between patients who required intra-aortic balloon pump (IABP) support and those who did not. This suggests that ventricular function was the primary determinant for IABP use in this cohort, rather than demographic or general clinical factors. Nevertheless, previous studies have demonstrated associations between IABP use and prolonged hospital and intensive care unit (ICU) stays.[12,19] It was observed that all IABP insertions in the present study occurred only in male patients, while this did not reach statistical significance. No significant associations of IABP insertion were found with smoking, diabetes, or hypertension status as well. This finding aligns with Kamal et al.[12] as they reported that diabetes, hypertension and smoking were not associated with IABP usage.

While the present study analyzed the frequency of IABP during CABG, Sohail et al.[16] demonstrated a significant benefit in terms of mortality with preoperative IABP insertion compared to perioperative insertion, they reported in-hospital mortality 20.7% for preoperative IABP usage, while 60% for perioperative. Similarly, Kralev et al.[3] found that prophylactic IABP in patients with LVEF <30% reduced postoperative low cardiac output syndrome and the need for vasoactive drugs. Zangrillo et al.[20] reported that preoperative IABP reduces perioperative mortality in high-risk CABG patients. These findings suggest that early, planned intervention may exhibited improved outcomes than rescue therapy. Current study provided a detailed characterization of a population with a low frequency of intra-aortic balloon pump (IABP) use during coronary artery bypass grafting (CABG). The significant association with reduced ejection fraction, in the absence of notable links to other comorbidities, underscores the central importance of ventricular function in determining IABP utilization within this cohort.

A few limitations of this study must be acknowledged. Only a small subset of patients received intra-aortic balloon pump (IABP) support, which limited the statistical power to detect meaningful differences and complicated comparative analyses. Consequently, the observed lack of association with various risk factors may reflect the restricted sample size rather than a true absence of relationship. Furthermore, as the study was conducted at a single center, the generalizability of these findings to broader populations and diverse clinical settings is limited.

Conclusion:

High risk CAD patients with lower ejection fraction, can benefit from IABP during CABG. Future studies need to be large, multicenter, randomized controlled trials with standardized definitions of high risk and protocol-driven management.

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Authors' contribution	
Abdur Rehman Khan	Study design, Introduction, Data collection, Data analysis, Discussion
Abdul Nasir	Supervision, Critical Analysis, Approval of manuscript.