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Predictive Value Of Pre-Operative Left Ventricular Ejection Fraction For Post-Operative Arrhythmia And Mortality Following Coronary Artery Bypass Grafting: An Observational Study

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Abstract

Background:: Following cardiac surgery, postoperative arrhythmias are frequent and substantial side effects. This study examines the wider prognostic practicality of decreased preoperative LVEF for postoperative consequences, including arrhythmias frequency, across a variety of cardiac surgical procedures, and mortality although it predicts poor outcomes in CABG. In patients having on pump CABG, this study seeks to determine if a lower preoperative LVEF is a risk factor of postoperative arrhythmia and mortality subsequent to them. **Methodology**: A cross sectional retrospective observational study was performed on 300 patients experiencing a preoperative left ventricular ejection fraction (LVEF) of ⩽40% who underwent coronary artery bypass grafting (CABG). The main results were in hospital mortality and postoperative arrhythmias. Chi Square test was used to assess association between preoperative LVEF values and postoperative arrhythmias and mortality. Binary

logistic regression analysis was performed to identify independent predictors, associated with postoperative arrhythmias and mortality. Statistical significance was defined as a p-value of less than 0.05. **Results:** The preoperative LVEF was notably decreased in patients who developed postoperative arrhythmias and those who experienced mortality. There was a significant association between reduced LVEF and these complications ($p<0.001$). LVEF was an independent predictor of arrhythmias and mortality in this study of 300 patients. **Conclusion:** Low preoperative LVEF is a strong independent predictor of postoperative arrhythmias and mortality in CABG patients. Those with severely reduced LVEF are at high risk for complications such as ventricular tachycardia, atrial fibrillation, and low cardiac output syndrome, underscoring the need for careful perioperative management despite the overall long term survival benefits of CABG.

Keywords:: Left ventricular ejection fraction (LVEF), postoperative arrhythmias, coronary artery bypass grafting (CABG) and mortality.

INTRODUCTION

Cardiopulmonary bypass (CPB) is a major advancement in cardiac surgery, temporarily replacing the function of the heart and lungs and enabling complex open heart procedures [1]. As a form of extracorporeal circulation, CPB supports circulatory, respiratory, and temperature regulation while providing a bloodless surgical field through drainage, oxygenation, and reinfusion of blood [2,3].

Coronary artery bypass grafting (CABG) uses autologous vessels such as the internal mammary artery or saphenous vein to bypass occluded coronary arteries caused by atherosclerosis [7]. It is widely performed, with approximately 400,000 procedures annually in the United States [4], and is particularly indicated in patients with severe coronary artery disease, including multivessel disease or left main coronary artery stenosis [8]. CABG improves survival, reduces angina, and enhances quality of life [9], yet ischemic heart disease remains a leading cause of mortality worldwide, accounting for 8.93 million deaths annually (15.96%) [10].

Despite its benefits, CABG carries risks, especially in patients with reduced left ventricular function. Mortality ranges from about 1% in patients with normal left ventricular ejection fraction (LVEF) to 7% in those with significantly reduced LVEF [11]. Advances in surgical techniques, patient selection, and perioperative care have improved outcomes [12], but

complications remain significant. LVEF, defined as the percentage of blood ejected from the left ventricle during systole, is a key indicator of cardiac function and a strong predictor of postoperative morbidity and mortality [14–16]. Patients with low preoperative LVEF (<40%) have nearly double the mortality risk and are more prone to complications such as myocardial infarction, heart failure, and ventricular arrhythmias [17,18].

Postoperative arrhythmias are common after cardiac surgery and contribute to increased morbidity, prolonged hospitalization, and higher healthcare costs [27]. Atrial fibrillation is the most frequent arrhythmia, occurring in 10–65% of patients, typically within the first few postoperative days [29,30]. It is associated with increased mortality and complications, although it is often self-limiting [36]. Ventricular arrhythmias are less common (0.41–1.4%) but are linked to higher long-term mortality, particularly in patients with left ventricular dysfunction [38–40]. Bradyarrhythmias may also occur and can compromise cardiac output [41,42].

Low LVEF has been consistently associated with adverse postoperative outcomes, including arrhythmias, low cardiac output syndrome, renal and respiratory failure, infection, and increased mortality [23,24]. Given the rising burden of coronary artery disease and heart failure with reduced ejection fraction, which has a five-year survival rate of approximately 25% [25,26], early identification of high-risk patients is essential.

Understanding the relationship between preoperative LVEF and postoperative arrhythmias and mortality in CABG patients is important for risk stratification, clinical decision-making, and improving surgical outcomes [43]. This study evaluates the prognostic value of preoperative LVEF in predicting postoperative arrhythmias and mortality, aiming to enhance perioperative management, optimize patient selection, and reduce complications through targeted interventions.

Methodology:

A cross sectional observational study design was used. Data were collected retrospectively from patient medical records over a four month period (September to December) at Rawalpindi Institute of Cardiology (RIC), Wazirabad Institute of Cardiology, Mega Medical Complex Rawalpindi, Peshawar, and Rehman Medical Institute, Peshawar.

The sample size was calculated using the single proportion formula with a 95%

confidence level (Z = 1.96), 5% margin of error, and an expected prevalence of 34% based on previous literature, resulting in an estimated sample size of 336; however, 300 patient records were included due to data availability.

Patients aged over 40 years who underwent on pump CABG with complete preoperative left ventricular ejection fraction (LVEF) records were included. Both male and female patients were considered, with particular focus on those with low EF and postoperative arrhythmias or mortality. Patients under 40 years, those who underwent off pump CABG, had incomplete EF records, preexisting arrhythmias, valvular surgeries, congenital heart disease, or non bypass related complications were excluded.

Data were extracted from surgical logs, perfusion reports, and hospital records using a pre structured proforma. Statistical analysis was performed using SPSS software. Descriptive statistics and inferential analyses were applied, with binary logistic regression used to assess the predictive value of preoperative LVEF for postoperative arrhythmias and mortality, and the Chi square test used to determine associations between variables.

Ethical approval was obtained from the BIHS Institutional Review Board (IRB), and confidentiality of patient data was maintained throughout the study.

RESULTS AND DISCUSSION

Demographics and Clinical Characteristics of the Study Population (N=300)

Table 1 shows the age distribution of 300 participants, with the majority (29.7%) in 54-60 year group (n = 89), followed by >60 years (27.0%, n = 81%). Triple Vessel Coronary Artery Disease (TVCAD) was the most common diagnosis (69.7%), followed by Double Vessel (18.7%) and Single Vessel (11.7%) disease. Hypertension was present in 47% of participants. The findings highlight a high prevalence of multi-vessel coronary artery disease. Nearly half the study population had hypertension, indicating a significant health trend. The findings indicating a noteworthy health trend within the studied group.

Table 1

Variable	Category	Frequency (n)	Percentage (%)
Age (Years)	40-45	62	20.7
	46-53	68	22.7

	54-60	89	29.7
	>60	81	27.0
Gender	Male	178	59.3
	Female	122	40.7
Diagnosis	SVCAD	35	11.7
	DVCAD	56	18.7
	TVCAD	209	69.7
Hypertension	Yes	141	47.0
	No	159	53.0

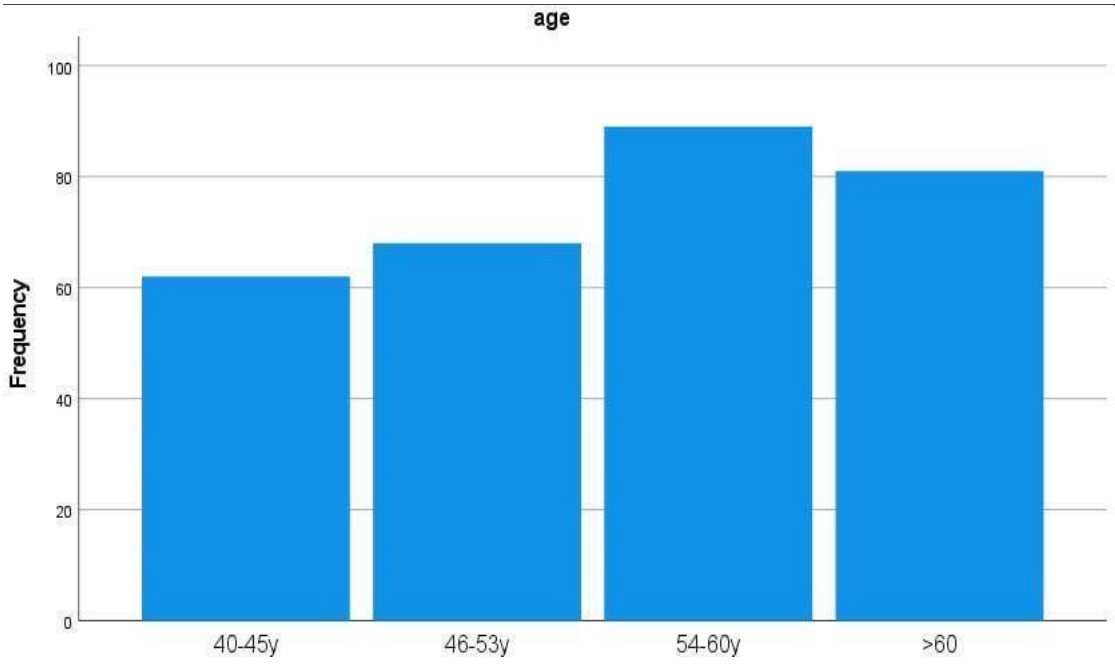

Fig: 1 Frequency Distribution of Age

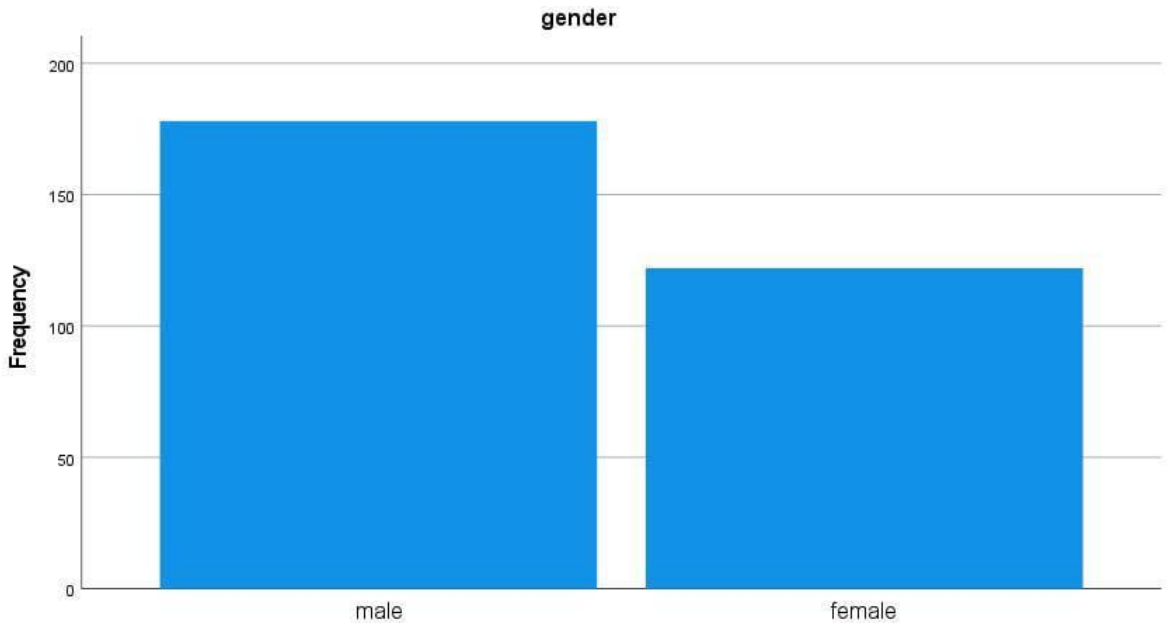

Fig: 2 Distribution of Participants by Gender

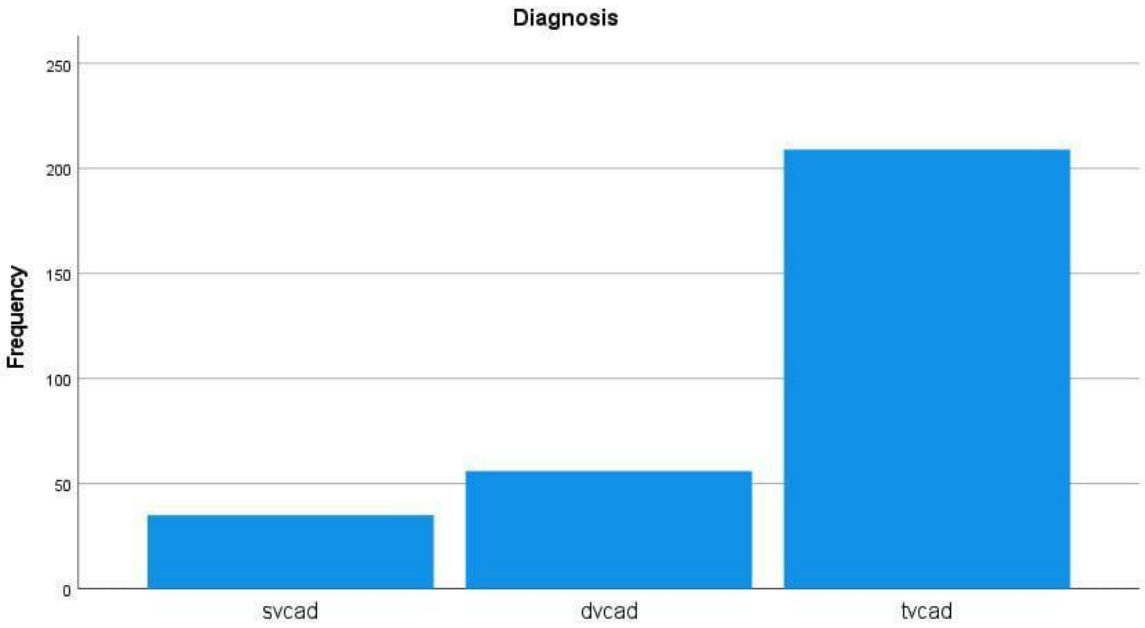

Fig: 3 Frequency Distribution of Patients Diagnosis

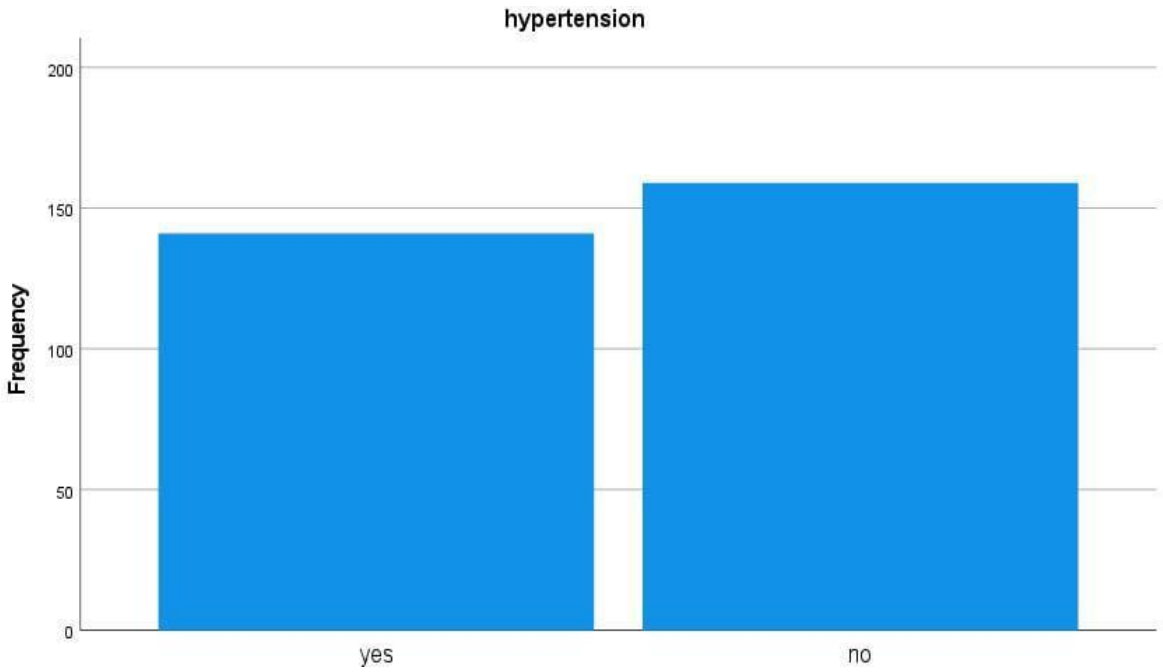

Fig: 4 Frequency Distribution of Hypertension

Distribution of Left Ventricular Ejection Fraction (LVEF) Categories Among Study Participants

Table 2 shows the 40-45 age group accounted for 31.7% (n = 95) of a sample, while the 46–50 age group coming in second at 30.7% (n = 92). Furthermore, 20.3% (n = 61) had an LVEF between 35 and 39 whereas, 17.3% (n = 52) of the individuals had an LVEF of below 35.

Table:

LVEF	46-50	92	30.7
	40-45	95	31.7
	35-39	61	20.3
	<35	52	17.3

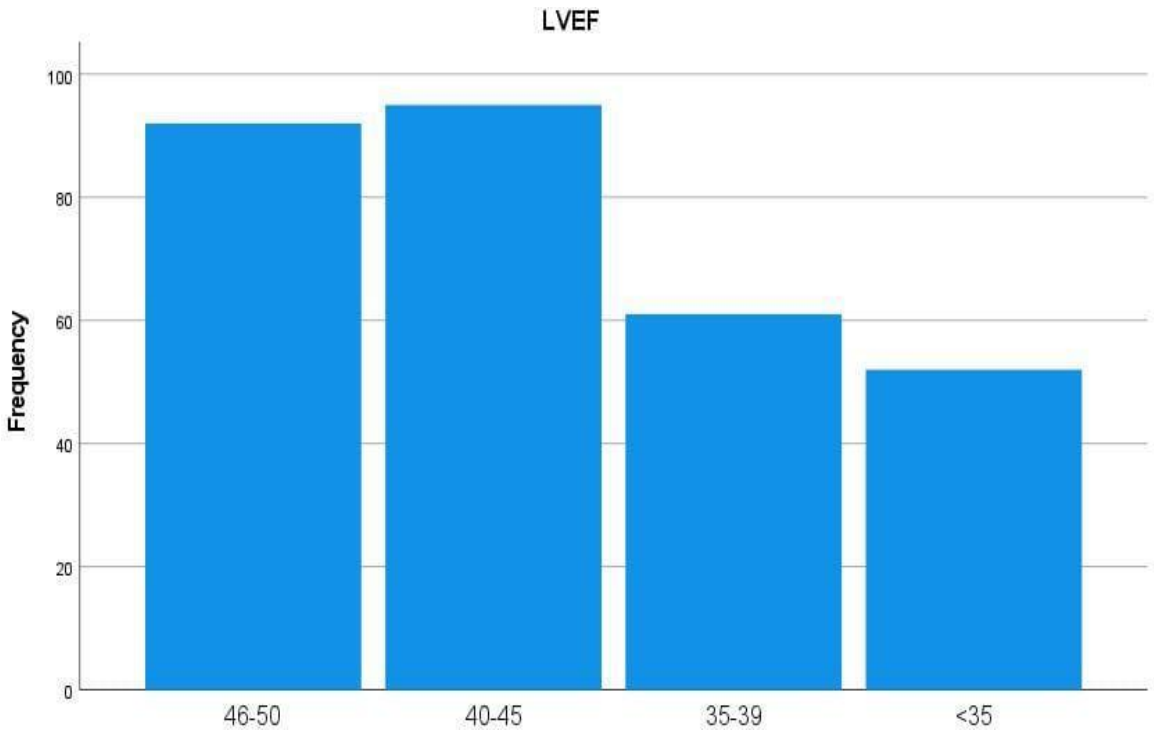

Fig:4.5 LVEF Patients Frequency by Range

Frequency Distribution of Clinical Outcomes

Table 3 represent with a prevalence rate of 65.0% (n = 195), arrhythmias affected the majority of the individuals. On the other hand, this condition was absent in 35.0% (n = 105) of the sample. In terms of mortality, the study found that 28.7% (n = 86) of the participants died during the study period, whilst 71.3% (n = 214) survived.

Table:

Variable	Category	Frequency (n)	Percentage (%)
Arrhythmias	Yes	195	65.0
	No	105	35.0
Mortality.	Yes	86	28.7
	No	214	71.3

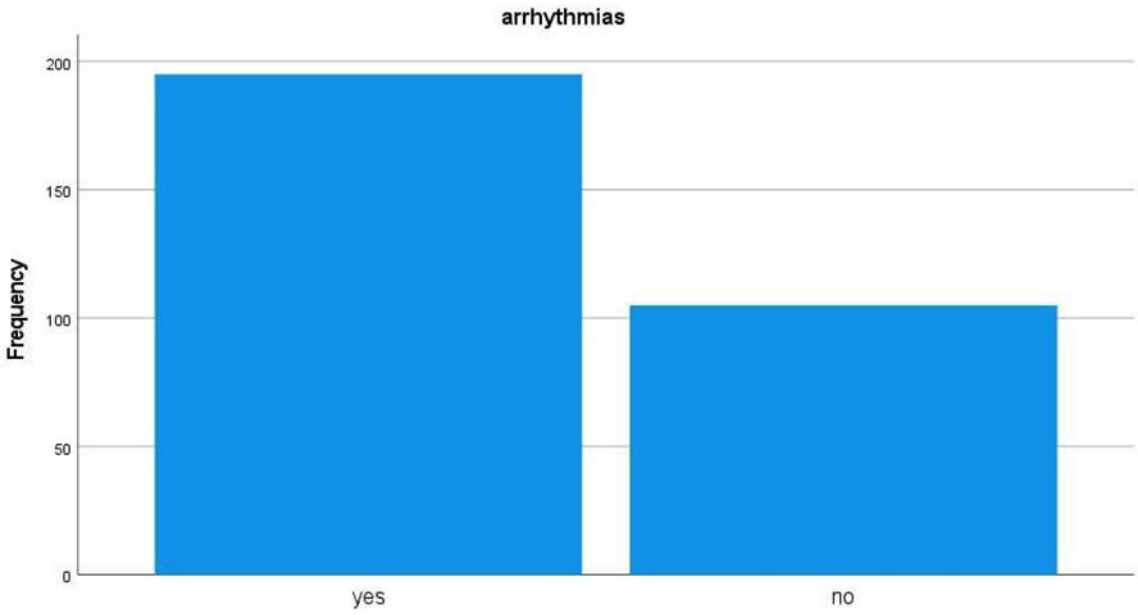

Fig: 6 Distribution of Patients by Arrhythmias

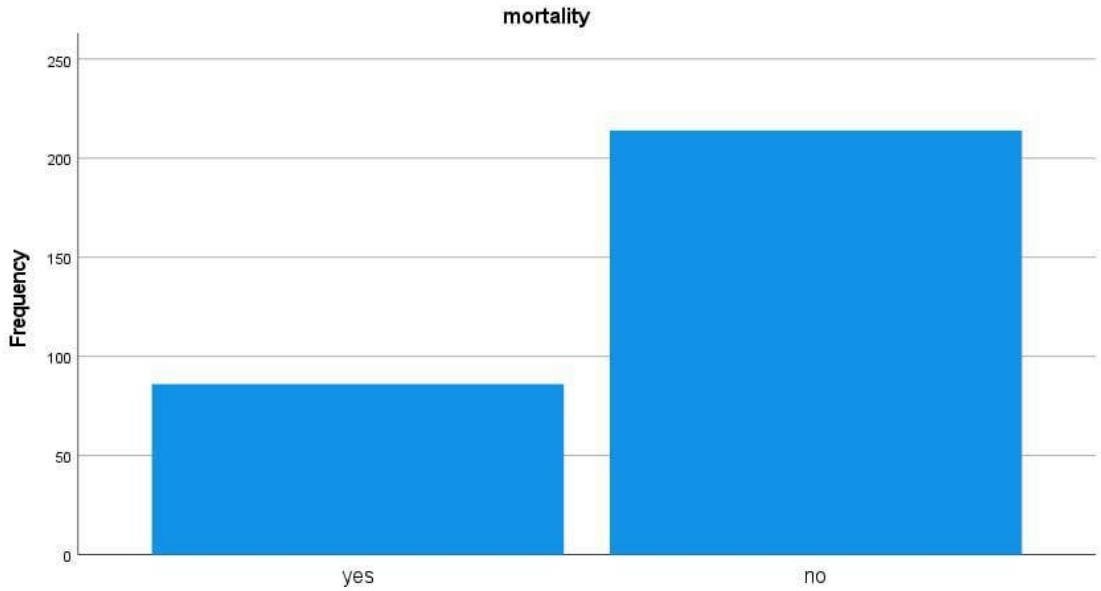

Fig:7 Frequency Distribution of Patient Mortality

Association between LVEF and Arrhythmias

Table 4 show that the significant relationship between left ventricular ejection fraction (LVEF) and postoperative arrhythmias has been identified in the analysis of

300 CABG patients (p<0.001). The incidence of arrhythmias increased dramatically with decreased LVEF: 46.7% in LVEF 46– 50, 55.8% in LVEF 40–45, 82.0% in LVEF 35–39, and 94.2% in LVEF <35. Reduced LVEF is
an important indicator of arrhythmic events, as illustrated by the fact that 65.0% of patients experienced arrhythmias overall.

Table: LVEF	Arrhythmias present, n (%)	Arrhythmias absent, n (%)	Total, n (%)	p-value
46-50	43 (46.7)	49 (53.3)	92 (30.7)	
40-45	53 (55.8)	42 (44.2)	95 (31.7)	
35-39	50 (82.0)	11 (18.0)	61 (20.3)	<0.001
<35	49 (94.2)	3 (5.8)	52 (17.3)	
Total	**195 (65.0)**	**105 (35.0)**	**300 (100)**	

N=300; LVEF= Left Ventricular Ejection Friction; **P<0.001=*Sig; Chi – Square

Association between LVEF and Mortality

Table 5 show that there was a statistically significant association (p<0.001) between postoperative mortality and left ventricular ejection fraction (LVEF) in the 300-patient sample. Reduced LVEF greatly raised mortality: 13.0% in LVEF 46–50, 9.5% in LVEF 40–45, 42.6% in LVEF 35–39, and 75.0% in LVEF <35. Lower LVEF is a major predictor of postoperative mortality, as seen by the overall mortality rate of 28.7% of patients.

Table: LVEF	Mortality present, n (%)	Mortality absent, n (%)	Total, n (%)	p-valve
46-50	12 (13.0)	80 (87.0)	92 (30.7)	
40-45	9 (9.5)	86 (90.5)	95 (31.7)	
35-39	26 (42.6)	35 (57.4)	61 (20.3)	<0.001
<35	39 (75.0)	13 (25.0)	52 (17.3)	
Total	**86 (28.7)**	**214 (71.3)**	**300 (100)**	

N=300; LVEF= Left Ventricular Ejection Friction; **P<0.001=*Sig; Chi – Square

Logistic Regression Analysis of LVEF with clinical outcomes

Table 6 illustrate the results of the logistic regression study looking at how Left

Ventricular Ejection Fraction (LVEF) affects clinical outcomes. Both results of p-values that are lower than

0.001 demonstrated that LVEF was a statistically significant predictor of both arrhythmia and mortality. LVEF had a negative regression coefficient (B = -0.), odds ratio of 0.418 (95% CI: 0.316-0.553) with arrhythmia indicating that depressed LVEF was associated with high risk of arrhythmias. The coefficient (B = -1.152) of LVEF on mortality was also negative indicating that there is an inverse relationship between LVEF and mortality risk. Reduced LVEFs had a high likelihood of death, as demonstrated in the statistically significant correlation ($p < 0.001$). On the whole, the regression analysis indicates the importance of LVEF in the risk stratification, as well as patient prognosis, as the results prove that LVEF is a significant and independent predictor of poor clinical outcomes.

a. Discussion:

This analysis assessed prediction capability of left ventricular preoperative LVEF in patients surgically subjected to CABG. The results confirm an important correlation between low LVEF and high rates of postoperative arrhythmias and mortality, and it is important to highlight that LVEF is a major predictor of negative outcomes. These findings are in line with the past data that has pointed out the preoperative LVEF as an effective predictor of postoperative outcome in patients who have undergone CABG.

The analysis of the logistic regression in the present study showed that lower LVEF was highly related to the occurrence of postoperative arrhythmias ($p < 0.001$). Patients who had lower LVEF had increased chances of arrhythmias as opposed to their counterparts with preserved ventricular function. Postoperative complications and mortality in patients are more likely to occur likely because of decreased LVEF [23]. Awan et al., (2020) demonstrated that the deterioration of preoperative LVEF is linked to the increased mortality of patients who underwent isolated CABG in the postoperative period [24]. The retrospective study by Ashkar and Khallaf (2019) concluded that the left ventricular functioning is an important independent predictor of early postoperative outcomes in CABG in the duration of the hospital stay and mortality, which makes it an important prognostic factor [57]. In another meta

analysis article by Bhuyan and Kawsar. (2023), the conclusion was that Patients with an EF less than 35% showed a significantly better death rate of 10.5% as compared 1.6% in patients with an EF higher than 50 and thus showed over six fold risk of early mortality [58].

Reduced LVEF preoperative patients were at higher risks of developing postoperative complications and mortality than normal LVEF ones [59]. In a cohort study, it was demonstrated that low LVEF is a predetermined risk factor in the development of complications following CABG [56]. The article by Herlitz et al., (1996) researched and did literature review on a strong correlation between preoperative LVEF and postoperative mortality; ventricular fibrillation was the leading cause of death, therefore LVEF is an important predictor of poor outcomes.

Our primary research variable is postoperative arrhythmias, which presents a serious problem since it is correlated with low LVEF, which is a significant risk factor. Previous study showed that patients who developed AF had a lower left ventricular ejection fraction as compared to those who have substantially higher LVEF, indicating a statistically significant difference [60]. Pieri et al., (2016) also concluded that Patients with low preoperative LVEF undergoing cardiac surgery face a higher risk of postoperative complications included arrhythmias and mortality [43].

A retrospective cohort study by Ismail et al. (2017), concluded poor left ventricular function is linked to an increased risk of developing AF in the general population. LVEF is an independent risk factor for postoperative arrhythmias and other complications [52]. Another study also highlights the high incidence of new onset VT/VF following CABG in patients with impaired left ventricular function, associated with significantly lower early and long term survival rates in the VT/VF group [45].

This paper has demonstrated the relevance of preoperative left ventricular ejection fraction as an important predictor of postoperative arrhythmias and death among patients undergoing coronary artery bypass grafting. The results confirm the current body of evidence and also highlight the importance of LVEF testing in the detection of high risk patients. Integrating LVEF into preoperative assessment can help to enhance clinical decision making and customized perioperative clinical management plans, which can positively affect the morbidity and mortality induced by arrhythmia.

The long term effects of LVEF on the postoperative outcomes should be further delimited in further studies with larger sample sizes and follow up time.

CONCLUSIONS AND RECOMMENDATIONS

This paper demonstrates low preoperative LVEF is a powerful and independent predictor of postoperative arrhythmias and mortality in patients undergoing CABG. The analysis using logistic regression demonstrated that there was a strong inverse correlation between LVEF and both outcomes, and low LVEF levels were the statistically significant risk factors of developing arrhythmias and mortality. Patients who had an LVEF less than 35% were extremely prone to ventricular tachycardia and postoperative atrial fibrillation, which usually led to the low cardiac output syndrome. The findings highlight that CABG enhances long term survival, patients with grossly low LVEF are at high risk of perioperative process and should be handled with care.

Limitations of study:

The theoretical framework did not allow many comparisons concerning the region due to the scarcity of literature on the Pakistani context. The methodologically used time of postoperative surveillance and the possibility of diagnostic results used in identifying arrhythmias and mortality were limited, which could have influenced the identification of some events. The research was carried out in very few centers of Rawalpindi and Peshawar which curtails the ability to generalize the research towards the broad population. The recommendation is to conduct future studies with bigger, multicenter cohorts, standardized diagnostic protocols as well as longer follow up studies to come up with stronger and more generalizable evidence.

Recommendations:

It follows based on these findings that LVEF measurement should be incorporated as a routine part of the preoperative assessment of CABG patients to identify high risk patients. Better perioperative care such as the continuous monitoring of the heart and early arrhythmia detection should be given to such patients. Individualized intensive care guidelines, prophylactic anti arrhythmic therapy, and intensive hemodynamic support should be the priorities to provide less complications and improved prognosis. Cardiologists, anaesthesiologists, and cardiac perfusionists should work together in multidisciplinary teams to improve patient outcomes. Also, further studies

on research should be conducted in multicentre studies with increased sample sizes, standardized follow up,
and extended follow up to further support these results and enhance perioperative management processes.

The theoretical framework was limited by the lack of literature that can be relevant to the Pakistani situation that limited the regional comparisons. The methodological limitations were the duration of postoperative observation and the presence of diagnostic test of arrhythmias and mortality which could have influenced the detection of certain events. The research was carried out in a few centers of Rawalpindi and Peshawar which restricts the externalization of the results to the rest of the population. It is suggested that future research with multicenter, large cohort with standard diagnostic protocols and extended follow up should be conducted to give more robust and generalizable evidence.

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