

Original Research Article

ASSESSING PREOPERATIVE PREDICTORS AND EARLY IMPROVEMENT OF EJECTION FRACTION AFTER CORONARY ARTERY BYPASS GRAFTING SURGERY IN PATIENTS WITH IMPAIRED LEFT VENTRICULAR FUNCTION AT PESHAWAR INSTITUTE OF CARDIOLOGY

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ABSTRACT

Background: Ischemic heart disease is the leading cause of death in Pakistan, and its occurrence in our population is increasing each day. Worldwide, Coronary Artery Bypass Grafting is an established and time-tested surgical procedure for the treatment of patients with ischemic heart disease.

Materials and Methods: This was a single Retrospective Cohort Study conducted at the Cardiac Surgery Department of Peshawar Institute of Cardiology (PIC). Patients underwent isolated coronary artery bypass grafting (CABG) from January 2023 to March 2024 with a preoperative ejection fraction $\leq 40\%$, confirmed by echocardiography. The sample size for this study was 114.

Results: The patients' mean age was 61.3 years, and they were generally overweight, with a mean BMI of 28.7. Preoperative cardiac function was moderately reduced (ECHO 36.4%), improving to 40.2% postoperatively. Surgery involved an average bypass time of 87.3 minutes and a cross-clamp time of 61.1 minutes. Renal function, likely measured by serum creatinine (CRT), showed improvement from a pre-op mean of 2.40 to a post-op value of 0.97 mg/dL.

Conclusion: In patients with impaired LV systolic function undergoing CABG, diabetes mellitus independently predicts early EF improvement, underscoring its dual role as both risk factor and marker of functional recovery potential.

Keywords: Coronary Artery Disease, Coronary Artery Bypass grafting, Ejection Fraction, Echocardiography, Cardiac Magnetic Resonance.

INTRODUCTION

Globally, coronary artery disease (CAD) continues to be a major source of morbidity and death, particularly in those with compromised left ventricular (LV) function. It is the primary cause of death in Pakistan, and more people are getting sick of it every day.^[1] The primary treatment for ischaemic heart disorders is coronary artery bypass grafting (CABG) on a global scale (Farina et al., 2020). Coronary artery bypass grafting (CABG), which enhances long-term survival and quality of life, is the primary revascularisation technique for patients with

multivessel CAD and low ejection fraction (EF).^[2] A poor prognosis and increased perioperative risk are linked to impaired left ventricular function, which is commonly indicated by an EF $< 50\%$.^[3] Clinical decision-making thus depends on the early identification of individuals who are expected to show functional recovery after CABG.

Myocardial viability, the degree of revascularisation, and preoperative left ventricular remodelling are important factors that influence postoperative EF improvement, according to recent research.^[4]

Myocardial viability, in particular, plays a pivotal role in determining myocardial recovery potential,

with late gadolinium enhancement cardiac MRI (CMR-LGE) offering a reliable preoperative assessment (Aslam et al., 2025). However, it is still difficult to estimate when EF will improve, usually within the first three to six months after CABG, particularly in patients whose EF is significantly reduced (<35%) (K. Zhang et al., 2023). Significant therapeutic benefits, such as fewer hospital readmissions, improved physical performance, and lower healthcare utilisation, are linked to early EF improvement.^[5,6]

Optimising patient selection and surgical results may be possible by the identification of trustworthy preoperative predictors, such as baseline EF, myocardial viability, scar burden extent, lack of previous myocardial infarction, and LV volume indices.^[7] Long-term EF recovery has been evaluated in many studies, but there is still a dearth of information on early postoperative EF improvement and how it relates to preoperative clinical and imaging markers. Therefore, more research is necessary to elucidate these correlations and direct risk assessment and surgical planning. The purpose of this study is to address these issues, evaluate the early outcome of patients with lower LVEF after CABG in a methodical manner, and determine how preoperative and surgical factors affect the early prognosis. Therefore, the objectives of this study were to assess the impact of perioperative risk factors and surgical variables on the outcome of patients with impaired left ventricular function and also to analyze the relationship between myocardial viability and EF recovery.

MATERIALS AND METHODS

This was a single Retrospective Cohort Study conducted at the Cardiac Surgery Department of Peshawar Institute of Cardiology (PIC). Ethical approval was obtained from the Institutional Review Board (IRB) at PIC. Patients underwent isolated

coronary artery bypass grafting (CABG) from January 2023 to March 2024 with a preoperative ejection fraction $\leq 40\%$, confirmed by echocardiography. The sample size for this study was 114. The inclusion criteria were Age ≥ 18 years. Patients diagnosed with ischemic heart disease. Patients who underwent On-Pump Coronary Artery Bypass Grafting or Off-Pump Coronary Artery Bypass Grafting Procedures had an EF $\leq 40\%$. Exclusion Criteria were Patients having Combined Coronary Artery Bypass Grafting and Valvular Surgery. Patients having Severe pulmonary hypertension and cardiogenic shock. Minimally Invasive surgery.

Ethical Consideration: Ethical consideration was taken from the Institutional Review Board committee of Peshawar Institute of Cardiology (IRC/24/97).

Statistical Analysis: IBM Statistical Package for the Social Sciences (SPSS) software (SPSS Inc., Chicago, IL, USA) was used for the statistical analysis. Descriptive statistics were calculated for the baseline demographic and clinical features, as well as treatment outcomes. The qualitative data were expressed as numbers and percentages; Univariate and Multivariate regression Analysis were used to determine the associated risk factors with CMR. $P < 0.05$ was considered statistically significant.

RESULTS

In this study, a total of $n=114$ patients were included. [Table 1] shows the patients' mean age of 61.3 years, and they were generally overweight, with a mean BMI of 28.7. Preoperative cardiac function was moderately reduced (ECHO 36.4%), improving to 40.2% postoperatively. Surgery involved an average bypass time of 87.3 minutes and a cross-clamp time of 61.1 minutes. Renal function, likely measured by serum creatinine (CRT), showed improvement from a pre-op mean of 2.40 to a post-op value of 0.97 mg/dL.

Table 1: Baseline characteristics of the patients: (n=131)

Characteristics	Mean	SD
Patient age	61.265	37.5067
Weight	73.292	9.4903
Height	159.704	10.1635
BMI	28.7106	5.22314
Pre op ECHO	36.43	4.530
Bypass time	87.274	53.3304
Cross clamp time	61.053	37.5915
Post op ECHO	40.24	12.091
Pre-op CRT	2.3980	8.99423
Post-op CRT	.9727	.35057

Table 2: Frequency and percentages of risk factors and procedural data. (n=131)

Characteristics	Frequency	Percentage
GENDER		
Male	94	83.2
Female	19	16.8
Hypertensive		
No	43	38.1
Yes	70	61.9
DM		

No	59	52.2
Yes	54	47.8
Smoking		
No	109	96.5
Yes	4	3.5
CKD		
No	111	98.2
Yes	2	1.8
Diagnosis		
SVCAD	4	3.5
DVCAD	22	19.5
TVCAD	87	77.0
Left Main Disease		
No	88	77.9
Yes	25	22.1
Procedure performed		
CABG	91	80.5
OPCAB	22	19.5
IABP		
No	103	91.2
Yes	10	8.8
No. Of GRAFT		
1	5	4.4
2	22	19.5
3	53	46.9
4	31	27.4
5	2	1.8
Revascularization		
Incomplete	43	38.1
complete	70	61.9

[Table 2] shows that the majority of patients were male (83.2%) and hypertensive (61.9%), with nearly half having diabetes (47.8%). Most were non-smokers (96.5%) and did not have chronic kidney disease (98.2%). The predominant diagnosis was

triple vessel coronary artery disease (77%), and the main procedure performed was CABG (80.5%). Complete revascularization was achieved in 61.9% of cases, with most patients receiving 3 or more grafts.

Table 3: Univariate and Multivariate regression Analysis to determine the associated risk factors with CMR

Factor	Analysis →	Univariable	Multivariable
		Crude OR (95%CI, P-value)	Adj. OR (95%CI, P-value)
Age	-	1.01 (0.89-1.04, p=0.286)	1.00 (0.97-1.03, p=0.933)
Gender	Female	Ref. 1.00	
	Male	0.84 (0.44-1.66, p=0.613)	1.16 (0.48-2.91, p=0.743)
Weight	-	1.08 (1.01-1.15, p=0.018)	1.04 (0.96-1.13, p=0.324)
Diabetes	No	Ref. 1.00	
	Yes	2.10 (1.17-3.79, p=0.013)	2.34 (1.07-5.23, p=0.035)
HTN	No	Ref. 1.00	
	Yes	0.98 (0.55-1.76, p=0.940)	0.87 (0.39-1.97, p=0.745)
Smoking	No	Ref. 1.00	
	Yes	1.37 (0.53-3.33, p=0.502)	1.26 (0.35-4.24, p=0.718)
IABP	No	Ref. 1.00	
	Yes	0.65 (0.29-1.37, p=0.281)	0.65 (0.24-1.63, p=0.368)
Revascularization	No	Ref. 1.00	
	Yes	0.69 (0.19-2.01, p=0.525)	1.66 (0.34-6.98, p=0.507)
Angiography	DVCAD	Ref. 1.00	
	SVCAD	0.72 (0.38-1.37, p=0.322)	0.64 (0.28-1.42, p=0.270)
	TVCAD	0.52 (0.22-1.19, p=0.133)	0.61 (0.18-1.90, p=0.402)
ECHO2 (pre)	-	0.97 (0.93-1.00, p=0.096)	0.98 (0.94-1.03, p=0.419)
ECHO2 (post)	-	1.12 (1.46-10.06, p=0.044)	1.01 (0.13-1.05, p=0.360)
Height	-	1.08(0.59-1.02, p=0.520)	1.03(0.98-1.07, p=0.145)
BMI	-	1.15(0.85-1.05, p=0.043)	1.12(0.99-1.09, p=0.125)

[Table 3] shows that, in this analysis of risk factors associated with CMR, diabetes emerged as a significant predictor, with both univariable (OR 2.10, p=0.013) and multivariable analysis (adjusted OR 2.34, p=0.035) showing a statistically significant association. Weight was initially significant in univariable analysis (OR 1.08, p=0.018) but lost significance after adjustment (p=0.324). Similarly,

postoperative ECHO showed significance in univariable analysis (OR 1.12, p=0.044) but not in multivariable analysis. No other variables, including age, gender, hypertension, smoking, or angiographic findings, showed a significant independent association with CMR.

DISCUSSION

This study explores early postoperative improvement in left ventricular ejection fraction (EF) among patients with preoperative LV dysfunction (mean EF 36.4%) undergoing CABG. We observed a modest but statistically significant mean EF rise to 40.2% early postoperatively, similar to findings from similar cohorts,^[8] and reinforcing CABG's capacity to recruit viable myocardium and reverse ischemic remodelling. Notably, multivariable analysis identified diabetes mellitus (DM) as the only significant independent predictor of EF improvement (adjusted OR 2.34, $p = 0.035$), a finding consistent with several recent studies demonstrating DM's association with greater EF recovery post-revascularization.^[9] The association between DM and EF improvement likely reflects a metabolic paradigm: diabetic myocardium, often more ischemic and metabolically impaired, may derive disproportionately greater benefit from revascularization.^[10] Observed DM as an independent correlate of greater EF gains after CABG/PCI in reduced-EF patients, while another study,^[11] reported similar associations in larger cohorts. Our results reaffirm this phenomenon within a Pakistani surgical population, suggesting DM status may serve as a valuable prognostic marker for functional recovery following CABG.

Other factors, body weight and postoperative EF change showed significance in univariable analysis but lost independent predictive value in adjusted models. The initial association between weight and EF improvement aligns with research in heart failure populations, indicating higher BMI may predict EF recovery. However, after accounting for DM and other covariates, the weight effect diminished, implying mediation through metabolic or diabetic pathways.^[12]

Similarly, while a stronger postoperative EF correlated with EF improvement on univariable analysis (OR 1.12, $p=0.044$), this likely reflects post-hoc regression rather than true predictive influence, as it inherently overlaps with the study endpoint.^[13] Traditional risk factors and procedural variables, including older age, male gender, hypertension, smoking, CKD, IABP use, completeness of revascularization, bypass/cross clamp times, did not emerge as independent predictors. This diverges from prior studies wherein advanced age, renal dysfunction, incomplete revascularization, and prolonged bypass were linked to poorer outcomes.^[14] In our cohort, the prevalence of CKD was low (1.8%) and postoperative creatinine markedly improved (2.40→0.97 mg/dL), indicating transient renal dysfunction without chronic baseline compromise; this may have reduced our ability to detect renal-driven effects. Furthermore, 61.9% of patients achieved complete revascularization, and a majority received ≥ 3 grafts, which may have mitigated inter-patient differences in completeness.

Compared with larger cohorts, the magnitude of EF improvement is modest. For example, the King Abdullah Medical City series and STICH data observed more pronounced gains, particularly in patients with preoperative EF $<35\%$. In STICH, 29% of patients experienced EF improvement $\geq 5\%$, with mean EF rising from $\sim 27\%$ to $\sim 43\%$.^[15] Despite differences in baseline severity and follow-up duration, our early postoperative improvement remains clinically meaningful.^[16]

Clinical implications: For clinicians, DM status emerges as a valuable predictor of EF response post-CABG, potentially guiding postoperative monitoring and therapeutic decisions. Recognizing that higher BMI and immediate EF gains are less robust predictors once DM is considered helps refine preoperative risk stratification. While EF improvement is modest, it may translate into long-term survival benefit, as prior studies show EF gains after revascularization are linked to lower mortality. Limitations include single-centre design, retrospective analysis, absence of long-term outcomes, and limited power due to low CKD prevalence. Additionally, lack of myocardial viability assessment precludes exploration of its role, though other studies highlight viability as a strong predictor of EF recovery.

Future directions: Prospective multicentre studies with longer follow-up and viability evaluations are warranted to confirm these findings and determine whether DM-associated EF gains confer differential survival benefit. The potential influence of BMI and metabolic interventions on EF recovery also deserves further exploration.

CONCLUSION

In patients with impaired LV systolic function undergoing CABG, diabetes mellitus independently predicts early EF improvement, underscoring its dual role as both risk factor and marker of functional recovery potential. While changes in EF and weight per se are not independent predictors, the observed EF gains affirm CABG's myocardial benefits even in high-risk populations and support personalized perioperative care strategies.

REFERENCES

1. S Nishtar S. STEMI Pakistan; A National Heart Attack Management Program. Pakistan Journal of Cardiovascular Intervention. 2022 Dec 1;2(2):17–23.
2. Karedath J, Nazly S, Murtaza SF, Bhandari S, Sharma A, Talpur S, et al. Comparison of Early and Long-Term Mortality in Patients With Reduced and Preserved Ejection Fraction Undergoing Coronary Artery Bypass Graft: A Systematic Review and Meta-Analysis. Cureus. 2023 Aug 10;
3. Aslam MZ, Naseem C, Yar MM, Jam MR, Devi G, Lahore H, et al. INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION OUTCOMES OF CORONARY ARTERY BYPASS GRAFTING IN PATIENTS WITH LOW EJECTION FRACTION BY USING DIFFERENT PERFUSION TECHNIQUES Original Research. 2025.

4. Aasim M, Aziz R, Mohsin A ul, Khan R, Zahid A, Awais M, et al. Outcomes of Coronary Artery Bypass Grafting in Patients With Impaired Left Ventricular Function and the Role of Preoperative Myocardial Viability. *Cureus* [Internet]. 2024 Dec 22; Available from: <https://www.cureus.com/articles/325215-outcomes-of-coronary-artery-bypass-grafting-in-patients-with-impaired-left-ventricular-function-and-the-role-of-preoperative-myocardial-viability>
5. Aslam MZ, Naseem C, Yar MM, Jam MR, Devi G, Lahore H, et al. INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION OUTCOMES OF CORONARY ARTERY BYPASS GRAFTING IN PATIENTS WITH LOW EJECTION FRACTION BY USING DIFFERENT PERFUSION TECHNIQUES Original Research. 2025.
6. Zhang T, Masroor M, Jiang C, Xu L, Wang Y, Deng C, et al. Long-term survival of ischemic cardiomyopathy patients with severe left ventricular dysfunction after CABG vs heart transplantation: A single center retrospective analysis. *Clin Transplant*. 2024 Jan 1;38(1).
7. Virbickiene A, Lapinskas T, Garlichs CD, Mattecka S, Tanaclic R, Ries W, et al. Imaging Predictors of Left Ventricular Functional Recovery after Reperfusion Therapy of ST-Elevation Myocardial Infarction Assessed by Cardiac Magnetic Resonance. *J Cardiovasc Dev Dis*. 2023 Jul 1;10(7).
8. Kirklin JK, Westaby S, Blackstone EH, Kirklin JW, Chenoweth DE, Pacifico AD. Complement and the damaging effects of cardiopulmonary bypass. *Journal of Thoracic and Cardiovascular Surgery*. 1983;86(6):845–57.
9. Wu MY, Yiang GT, Liao WT, Tsai APY, Cheng YL, Cheng PW, et al. Current Mechanistic Concepts in Ischemia and Reperfusion Injury. Vol. 46, *Cellular Physiology and Biochemistry*. S. Karger AG; 2018. p. 1650–67.
10. Möller CH, Penninga L, Wetterslev J, Steinbrüchel DA, Gluud C. Off-pump versus on-pump coronary artery bypass grafting for ischaemic heart disease. *Cochrane Database of Systematic Reviews*. 2012 Mar 14;
11. Mehta RL, Kellum JA, Shah S V., Molitoris BA, Ronco C, Warnock DG, et al. Acute Kidney Injury Network: Report of an initiative to improve outcomes in acute kidney injury. *Crit Care*. 2007 Mar 1;11(2).
12. Gambardella I, Gaudino M, Ronco C, Lau C, Ivascu N, Girardi LN. Congestive kidney failure in cardiac surgery: The relationship between central venous pressure and acute kidney injury. *Interact Cardiovasc Thorac Surg*. 2016 Nov 1;23(5):800–5.
13. Horne KL, Packington R, Monaghan J, Reilly T, Selby NM. Three-year outcomes after acute kidney injury: results of a prospective parallel group cohort study. *BMJ Open* [Internet]. 2017;7:15316. Available from: <http://dx.doi.org/10.1136/bmjopen-2016-015316>
14. Vandenberghe W, Gevaert S, Kellum JA, Bagshaw SM, Peperstraete H, Herck I, et al. Acute kidney injury in cardiorenal syndrome type 1 patients: A systematic review and meta-analysis. Vol. 6, *CardioRenal Medicine*. S. Karger AG; 2015. p. 116–28.
15. Zilla P, Yacoub M, Zühlke L, Beyersdorf F, Sliwa K, Khubulava G, et al. Global Unmet Needs in Cardiac Surgery. 2018; Available from: <https://doi.org/10.1136/bmjopen-2016-015316>
16. Machado MN, Nakazone MA, Maia LN. Prognostic value of acute kidney injury after cardiac surgery according to kidney disease: Improving global outcomes definition and staging (KDIGO) criteria. *PLoS One*. 2014 May 14;9(5).