Section: Cardio-Thoracic Surgery

Original Research Article

RETROSPECTIVE ANALYSIS OF IN-HOSPITAL SURVIVAL OF PATIENTS WHO UNDERWENT CORONARY ARTERY BYPASS GRAFTING (CABG) FOR SEVERE LEFT VENTRICULAR DYSFUNCTION

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ABSTRACT

Background: Patients with severe left ventricular (LV) dysfunction undergoing coronary artery bypass grafting (CABG) represent a high-risk group with variable postoperative outcomes. Identifying predictors of in-hospital mortality is essential for improving perioperative management and survival. The objective to evaluate preoperative, intraoperative, and postoperative determinants of in-hospital survival in patients with severe LV dysfunction undergoing CABG. **Materials and Methods:** This retrospective observational study included 100 patients with an ejection fraction ≤35% who underwent CABG. Preoperative variables such as demographic data, comorbidities, echocardiographic findings, and angiographic characteristics were recorded. Intraoperative parameters including type of surgery, cardiopulmonary bypass (CPB) duration, aortic cross-clamp time, and intra-aortic balloon pump (IABP) usage were analyzed. Postoperative outcomes such as complications, inotropic support, ventilation duration, ICU stay, and in-hospital mortality were assessed. **Result:** Out of 100 patients, 78 survived and 22 expired during hospitalization. Advanced age, chronic kidney disease, prolonged CPB and cross-clamp times, and the need for IABP were significantly associated with mortality. Postoperative complications, including infections, arrhythmias, and low cardiac output state, were more frequent among non-survivors. Despite severe LV dysfunction, acceptable survival outcomes were achieved in the majority of patients. These findings are consistent with existing literature. **Conclusion:** In patients with severe LV dysfunction undergoing CABG, mortality is primarily influenced by advanced age, renal dysfunction, impaired cardiac function, operative complexity, and postoperative complications. Careful patient selection, optimized intraoperative management, and vigilant postoperative care are crucial to improving outcomes in this high-risk population.

INTRODUCTION

Coronary artery disease (CAD) continues to be a major global contributor to illness and death. This risk is particularly heightened in individuals with significantly reduced left ventricular ejection fraction (LVEF ≤30–35%).[1] Among treatment options, coronary artery bypass grafting (CABG) remains a primary revascularization strategy, especially for patients with multivessel disease or significant left main coronary involvement. It is widely utilized in cases of ischemic cardiomyopathy, where it not only alleviates symptoms but also contributes to improved survival.

Managing these patients is complex due to their compromised cardiac function, presence of multiple comorbidities, and vulnerability to perioperative complications like low cardiac output and ischemia-reperfusion injury. Nevertheless, CABG is frequently pursued for its ability to enhance myocardial perfusion, potentially revive hibernating myocardium, and offer long-term survival benefits over medical therapy alone, as supported by trials like STICH and STICHES.[2]

Low LVEF has been repeatedly associated with increased early postoperative mortality. These patients often experience hemodynamic instability, arrhythmias, and difficulty in separating from cardiopulmonary bypass. Conditions such as chronic

kidney disease, diabetes, prior myocardial infarction, and pulmonary hypertension further elevate surgical risk. Observational studies have reported in-hospital death rates between 5% and 10% in this high-risk group, influenced by factors across the perioperative period.[3]

Additionally, outcomes are affected by institutional case volume, surgeon expertise, bypass duration, and completeness of grafting. The debate continues regarding the best surgical approach—on-pump or off-pump CABG—in patients with impaired ventricular function. While off-pump CABG may reduce inflammation and shorten ICU stays, its effectiveness in complete revascularization remains questioned.

Mechanical circulatory support options such as intra-aortic balloon pump (IABP), ECMO, or ventricular assist devices (VADs) have become important tools, especially in managing patients with significant ventricular dilation or low-output states. However, the optimal timing for their use—whether preventative or reactive—remains uncertain.[4]

Postoperative complications are more common in this subgroup and include low output syndrome, renal failure, stroke, infections, and arrhythmias, all of which contribute to extended hospital stays and mortality. Individualized care, early recognition of complications, and careful use of inotropes are critical. Nonetheless, excessive inotrope use may lead to increased oxygen demand and adverse cardiac remodeling.[5]

Although predictive models such as EuroSCORE II and STS risk calculators include LV function, their applicability across varied patient populations is limited. In settings with limited access to advanced perioperative technologies, such as low- and middle-income countries, early identification of modifiable risk factors becomes essential for planning and improving outcomes. Additionally, there is limited evidence from South Asian cohorts addressing predictors of early CABG mortality in patients with severe LV dysfunction, highlighting the need for focused regional research. Accordingly, the present study undertakes a retrospective evaluation of in-hospital survival in patients undergoing CABG with significantly reduced LVEF.

MATERIALS AND METHODS

Study Design: A Retrospective observational study
Study Period: January 2021 to December 2024.

Source of Data: CAD patients, who underwent surgical coronary revascularization for severe LV dysfunction from January 2021 to December 2024, who were treated at dept of CVTS, Nizams institute of medical sciences.

Sample Size: 100 patients.

Approval was obtained by the Institutional Ethics Committee before commencing the study, and a waiver of informed consent was obtained from ethics committee as the study is retrospective observational study.

Inclusion Criteria:

- CAD patients in the age group of 18yrs and above
- Patients with LV ejection fraction <35% and undergone coronary artery bypass grafting (CABG).
- Patients willing to give informed consent.
- Exclusion Criteria:
  Patients underwent additional surgical procedures not directly related to ischemic cardiomyopathy like aortic valve replacement, tricuspid valve surgery, associated congenital heart surgery etc.
- CAD patients with severe LV dysfunction who underwent additional surgical procedures, along with CABG, like mitral valve surgery for ischemic mitral regurgitation and ventricular restoration procedures, for associated left ventricular aneurysm/ left ventricular free wall rupture/ ischemic ventricular septal rupture.
- Patients not willing to give informed consent.

Methodology: 100 CAD patients, who underwent surgical coronary revascularization for severe LV dysfunction from January 2021 to December 2024, who were treated at dept of CVTS, Nizams institute of medical sciences were included in the study and data collection was done for the pre, post and intra operative variables.

Data Collection: Demographic information, preoperative details including symptoms, risk factors, and diagnostic investigations, intraoperative parameters such as number of grafts, cardiopulmonary bypass time, cross-clamp duration, and concurrent procedures, and postoperative outcomes including duration of ICU stay, ventilator support, hospital stay, infections, and mortality were all recorded. These data were systematically entered into a Microsoft Access database for analysis.

Statistical Analysis: The data were analyzed using IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized using mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Associations between categorical variables and in-hospital mortality were assessed using the Chi-square test or Fisher's Exact test where appropriate.

To identify factors associated with mortality, univariate analysis was initially performed. Variables with a p-value less than 0.05 in univariate analysis were entered into a multivariate logistic regression model to determine independent predictors of mortality, and results were reported as adjusted odds ratios (ORs) with 95% confidence intervals (CIs). A p-value < 0.05 was considered statistically significant for all analyses.

RESULTS

A total of 100 patients undergoing CABG were included in the study. The in-hospital outcomes,

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clinical characteristics, perioperative variables, and factors associated with mortality are summarized below.

Table 1: Overall Outcome

Outcome	Frequency	Percentage
Survived	78	78%
Expired	22	22%

Among the study population, 78% of patients survived, while 22% experienced in-hospital mortality.

Table 2: Causes of Mortality

Cause	Frequency	Percentage
Cardiac	11	50%
CKD	7	31.8%
Septicemia	3	13.7%
CVA	1	4.5%

Cardiac-related events were the most common cause of death, followed by renal failure and septic complications.

Table 3: Age Distribution and Outcome

Age Group (years)	Survived n (%)	Expired n (%)
31–40	13 (16.7%)	0 (0%)
41–50	14 (17.9%)	3 (13.6%)
51–60	30 (38.5%)	14 (63.6%)
61–70	21 (26.9%)	5 (22.7%)

p = 0.002

Advanced age was significantly associated with mortality, with the highest proportion of deaths occurring in older age groups.

Table 4: Gender Distribution and Outcome

Gender	Survived n (%)	Expired n (%)
Male	60 (76.9%)	15 (68.2%)
Female	18 (23.1%)	7 (31.8%)

p = 0.95

Gender did not significantly influence mortality outcomes.

Table 5: Comorbidities and Outcome

Comorbidity	Survived n (%)	Expired n (%)	p-value
Hypertension	52 (66.7%)	6 (27.3%)	0.04
Diabetes Mellitus	48 (61.5%)	6 (27.3%)	0.18
Smoking	36 (46.2%)	5 (22.7%)	0.08
Dyslipidaemia	32 (41.0%)	4 (18.2%)	0.15
CKD	19 (24.4%)	7 (31.8%)	0.038
Peripheral VD	3 (3.8%)	2 (9.1%)	0.02

CKD and peripheral vascular disease were significantly associated with mortality, whereas other comorbidities were not.

Table 6: Past Medical History

History	Survived n (%)	Expired n (%)	p-value
CVA/Syncope	2 (2%)	2 (22%)	0.01
CKD	13 (14%)	4 (44%)	0.002
AKI	2 (2%)	1 (11%)	0.09
MI	57 (73.1%)	18 (81.8%)	0.042

Previous CKD and CVA were strongly associated with mortality.

Table 7: Functional Status (NYHA Class)

Class	Survived n (%)	Expired n (%)
I	18 (20%)	0 (0%)
II	46 (51%)	1 (11%)
III	25 (27%)	6 (67%)
IV	2 (2%)	2 (22%)

p = 0.003

Higher NYHA class was significantly associated with increased mortality.

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Table 8: Angina Severity (CCS Class)

Class	Survived n (%)	Expired n (%)
I	16 (18%)	0 (0%)
II	41 (45%)	2 (22%)
III	30 (33%)	5 (56%)
IV	4 (4%)	2 (22%)

p = 0.02, Higher CCS class correlated significantly with mortality.

Table 9: Ejection Fraction

EF (%)	Survived n (%)	Expired n (%)
<25%	12 (13%)	6 (67%)
25–30%	35 (38%)	2 (22%)
31–35%	44 (48%)	1 (11%)

p = 0.0001, Low EF (<25%) was a strong predictor of mortality.

Table 10: Perioperative and Postoperative Factors

Variable	Significant Finding
Inotrope support	Higher in non-survivors (p=0.02)
Ventilation >8 hrs	Higher mortality (p=0.001)
ICU stay >7 days	Strong association (p=0.0005)
Infections	Higher in non-survivors (p=0.008)
Arrhythmia	Significant association (p=0.032)

Postoperative complications were major determinants of mortality.

Table 11: Intraoperative Parameters

Parameter	Survivors	Non-survivors	p-value
CPB duration (min)	96.4 ± 18.2	114.5 ± 12.3	0.01
Aortic Cross-clamp time (min)	72.6 ± 16.4	91.3 ± 12.4	0.02

Longer operative times were significantly associated with mortality.

Table 12: Univariate and Multivariate analysis of factors associated with mortality

Factor	Survived n (%)	Expired n (%)	p-value
Age >60	21 (26.9%)	5 (22.7%)	0.002*
Male gender	60 (76.9%)	6 (27.3%)	0.95
Hypertension	52 (66.7%)	6 (27.3%)	0.04
Diabetes	48 (61.5%)	6 (27.3%)	0.18
CKD	19 (24.4%)	7 (31.8%)	0.038
EF <25%	12 (15.4%)	6 (27.3%)	<0.001
Severe MR	2 (2.6%)	6 (27.3%)	<0.001
Inotrope use	25 (32.1%)	17 (77.3%)	0.002
Vent >8 h	11 (14.1%)	16 (72.7%)	0.001
ICU >5 d	18 (23.1%)	18 (81.8%)	<0.001
Infections	7 (9.0%)	20 (90.9%)	0.008
Arrhythmia	35 (44.9%)	14 (63.6%)	0.005

Univariate analysis identified several significant predictors of in-hospital mortality, including advanced age (>60 years), CKD, low EF (<25%), severe mitral regurgitation, and postoperative complications such as inotrope requirement, prolonged ventilation, extended ICU stay, infections, and arrhythmias. Higher NYHA and CCS classes were also associated with poor outcomes. In contrast, hypertension and diabetes were more common among survivors, possibly reflecting baseline differences. Overall, mortality risk was driven by poor cardiac function, comorbidities, and perioperative complications following CABG.

Table 13: Multivariate logistic regression analysis

Factor	Adjusted OR	95% CI	p-value
Age >60	5.5	1.3 – 23.8	0.02
EF <25%	9.2	2.0 – 42.1	0.003
CKD	4.8	1.1 – 21.7	0.04
Severe MR	7.0	1.4 – 35.1	0.02
Inotrope use	3.9	1.0 – 14.7	0.05

Multivariate analysis identified age >60 years, EF <25%, CKD, severe mitral regurgitation, and **inotrope use** as independent predictors of in-hospital mortality. These findings highlight that poor cardiac function, renal dysfunction, valvular disease, and perioperative hemodynamic instability are the key determinants of mortality after CABG.

DISCUSSION

Coronary artery bypass grafting (CABG) in patients with severe left ventricular (LV) dysfunction (ejection fraction ≤35%) represents a high-risk yet clinically significant intervention. These patients typically present with advanced coronary artery

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disease, impaired myocardial reserve, and multiple comorbidities, all of which contribute to increased perioperative morbidity and mortality. Despite these challenges, CABG remains a cornerstone in the management of ischemic cardiomyopathy due to its potential to improve myocardial perfusion, restore hibernating myocardium, and enhance long-term survival. Large trials such as STICH and STICHES have demonstrated that although early mortality may be higher in this subset, long-term survival and functional outcomes are significantly improved with surgical revascularization.

The present study aimed to identify determinants of in-hospital mortality in patients with severe LV dysfunction undergoing CABG in a real-world Indian cohort. Our findings highlight that mortality is multifactorial, involving a complex interplay of preoperative risk factors, intraoperative variables, and postoperative complications.

Preoperative Factors: Among preoperative variables, age emerged as a significant determinant of mortality. Patients aged above 60 years had a significantly higher risk of in-hospital death, which aligns with global literature. Aging is associated with reduced physiological reserve, increased comorbidity burden, and diminished myocardial recovery potential, all of which contribute to adverse outcomes. Similar demographic trends have been reported by Ponnuru et al,[6] and Jose et al,[7] where the majority of patients were in their fifth and sixth decades. However, Western studies such as those by Melina et al,[8] and Ascione et al,[9] reported older patient populations, suggesting that Indian patients tend to present earlier with ischemic heart disease.

Gender did not significantly influence outcomes in our study, consistent with previous reports. Although males constituted the majority of the study population, survival rates were comparable between genders. This finding indicates that biological sex may play a limited role in determining short-term postoperative outcomes in this high-risk group.

Left ventricular function remains one of the most critical predictors of outcome. In our cohort, all patients had severe LV dysfunction, yet those with extremely low EF (<25%) demonstrated significantly higher mortality. This is consistent with findings from Jose et al.[7] who showed that improvement in EF postoperatively strongly predicts long-term survival. Similarly, Koene et al,[10] demonstrated that patients with reduced baseline EF derive the greatest benefit from revascularization due to reverse remodeling and improved contractility. These observations reinforce that while low EF is a marker of high risk, it does not contraindicate surgery; rather, it underscores the need for careful patient selection and perioperative optimization.

Functional status, as assessed by NYHA and CCS classifications, also played a significant role. Higher NYHA and CCS classes were associated with increased mortality, reflecting the severity of symptomatic disease and reduced physiological reserve. These findings are consistent with prior studies, which have shown that advanced functional class correlates with poorer outcomes due to chronic myocardial stress and limited compensatory mechanisms.

Chronic kidney disease (CKD) was another important preoperative risk factor identified in our study. CKD was significantly more prevalent among non-survivors and also emerged as an independent predictor of mortality. Renal dysfunction contributes to fluid overload, electrolyte imbalance, and systemic inflammation, all of which complicate perioperative management. Similar observations have been reported in studies by Jose et al,[7] and Ponnuru et al,[6] emphasizing the importance of renal function as a prognostic marker in CABG patients with LV dysfunction.

Angiographic findings in our study revealed a predominance of triple vessel disease and left main coronary artery involvement, reflecting advanced ischemic burden. This pattern is consistent with Indian and global literature, where diffuse coronary artery disease is common in patients with ischemic cardiomyopathy. While the extent of disease did not independently predict mortality in our cohort, studies such as those by Melina et al,[8] have demonstrated that coronary complexity, as assessed by SYNTAX score, significantly influences outcomes. Thus, it is not merely the number of diseased vessels but the complexity and completeness of revascularization that determine prognosis.

Intraoperative Factors: Intraoperative variables are critical determinants of early postoperative outcomes. In our study, prolonged cardiopulmonary bypass (CPB) duration and aortic cross-clamp time were significantly associated with increased mortality. These findings are consistent with existing literature, where longer operative times are associated with increased myocardial ischemia, systemic inflammatory response, and risk of organ dysfunction.

The requirement for intra-aortic balloon pump (IABP) support was markedly higher among non-survivors, indicating severe intraoperative hemodynamic instability. IABP serves as a mechanical support device to augment coronary perfusion and reduce afterload, but its use often reflects underlying myocardial compromise. Similar findings have been reported by Ascione et al,[9] who noted higher IABP usage in patients undergoing more complex surgeries. Thus, IABP requirement can be considered a surrogate marker of operative severity and myocardial reserve exhaustion.

Regarding surgical technique, most patients in our study underwent on-pump CABG, with no significant difference in outcomes compared to off-pump procedures. This observation aligns with studies by Jose et al,[7] which reported comparable long-term survival between on-pump and off-pump CABG. While off-pump surgery may offer advantages in selected patients by avoiding CPB-related complications, the choice of technique should

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be individualized based on patient characteristics and surgical expertise.

The number of grafts performed did not significantly influence mortality in our study. This suggests that completeness of revascularization, rather than the absolute number of grafts, is more important in determining outcomes. Ponnuru et al,[6] also reported favorable outcomes despite extensive grafting, highlighting that aggressive revascularization is justified in patients with diffuse disease.

Postoperative Factors: Postoperative complications emerged as the strongest determinants of in-hospital mortality in our study. Prolonged mechanical ventilation, extended ICU stay, inotropic support, infections, and arrhythmias were all significantly associated with adverse outcomes.

Prolonged ventilation (>8 hours) was significantly more common among non-survivors, indicating respiratory compromise and hemodynamic instability. Similarly, extended ICU stay (>5 days) was strongly associated with mortality, reflecting the severity of postoperative complications. These findings emphasize the importance of early extubation protocols and optimized ICU care in improving outcomes.

Inotropic support was required more frequently among non-survivors, suggesting persistent low cardiac output syndrome. This condition is a major cause of early mortality in patients with severe LV dysfunction and reflects inadequate myocardial recovery despite revascularization.

Postoperative infections, particularly surgical site infections and respiratory infections, were significantly higher among non-survivors. Sepsis contributes to systemic inflammatory response, multiorgan dysfunction, and increased mortality. Similar findings have been reported in previous studies, underscoring the importance of strict infection control measures and early intervention.

Arrhythmias were also more common among non-survivors, indicating electrical instability of the myocardium. These disturbances can lead to hemodynamic compromise and increased mortality if not promptly managed.

Biochemical and Systemic Factors: Renal dysfunction emerged as a critical determinant of mortality in our study. CKD was both a preoperative risk factor and a major contributor to postoperative mortality. The interplay between renal and cardiac dysfunction, often referred to as the cardiorenal syndrome, significantly complicates perioperative management.

Inflammatory processes, although not directly quantified, were evident through the occurrence of septicemia in a significant proportion of non-survivors. Systemic inflammation plays a crucial role in postoperative complications, particularly in patients undergoing CPB.

Comparison with Existing Literature: Our findings are largely consistent with existing literature. Studies by Jose et al,[7] Ponnuru et al,[6] and Ascione et al,[9] have reported similar predictors of mortality, including advanced age, reduced EF, renal dysfunction, and postoperative complications.

The STICH and STICHES trials have demonstrated that CABG offers significant long-term survival benefits in patients with ischemic cardiomyopathy, despite higher early mortality. Our study supports these findings by showing that, although in-hospital mortality is notable, the majority of patients survive and potentially benefit from revascularization.

Clinical Implications: The results of our study have important clinical implications. Preoperative risk stratification should focus on identifying high-risk patients based on age, EF, renal function, and functional status. Intraoperative strategies should aim to minimize CPB and cross-clamp time and ensure adequate myocardial protection. Postoperative care should prioritize early detection and management of complications such as low cardiac output, infections, and arrhythmias.

Limitations: This study has several limitations. Being a single-center retrospective study, it is subject to selection bias and limited generalizability. Certain variables, including detailed biochemical markers and long-term follow-up data, were not available. Additionally, postoperative echocardiographic assessment was not uniformly performed, limiting evaluation of functional recovery.

CONCLUSION

This study provides valuable insight into the multifactorial determinants of early postoperative outcomes in patients with severe left ventricular dysfunction undergoing coronary artery bypass grafting. The analysis revealed that advanced age and chronic kidney disease were significant preoperative predictors of mortality. Intraoperatively, longer cardiopulmonary bypass and cross-clamp durations, as well as the need for intra-aortic balloon pump (IABP) support, were strongly associated with poor outcomes. These findings suggest that prolonged operative times and intraoperative hemodynamic instability serve as indicators of surgical complexity and myocardial vulnerability. Postoperatively, complications such as low cardiac output syndrome, sepsis, and prolonged mechanical ventilation were disproportionately higher in non-survivors, reinforcing the importance of vigilant monitoring and aggressive supportive care in the early recovery period.

Despite the high-risk nature of the cohort, the majority of patients survived and demonstrated clinical stability, highlighting that CABG remains a viable and effective revascularization strategy in patients with severely reduced ejection fraction when combined with appropriate perioperative management. The findings from this study align with existing global data and contribute to the growing evidence that timely surgical intervention, individualized intraoperative decision-making, and proactive management of postoperative

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complications can significantly influence survival. These insights underscore the need for comprehensive risk stratification tools that integrate not only EF but also operative and postoperative variables to better guide decision-making and resource allocation in this vulnerable population.

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