Feasibility of off-pump coronary artery grafting for patients with impaired left ventricular ejection fraction: a retrospective cohort study from a single institutional database

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Abstract

Despite great advances in surgeries, the management of patients with impaired left ventricular ejection fraction is still challenging. Furthermore, evidences on outcomes of off-pump coronary artery bypass surgery (OPCAB) in this population are inconsistent. We conducted present study to compare the short and long-term outcomes in patients with different ejection fractions undertaken OPCAB.

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Key words: Off-pump coronary artery bypass surgery; Left ventricular dysfunction; Long-term outcomes; Propensity Score Matching

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Abstract:

Objectives: Despite great advances in surgeries, the management of patients with impaired left ventricular ejection fraction is still challenging. Furthermore, evidences on outcomes of off-pump coronary artery bypass surgery (OPCAB) in this population are inconsistent. We conducted present study to compare the short and long-term outcomes in patients with different ejection fractions undertaken OPCAB.

Methods: This retrospective cohort used data from the HuaShan Cardiac-surgery Registry and included the consecutive patients aged [?] 18 years who were underwent OPCAB procedures during 2007-2019. Patients included in the study were followed until death or the end of data collection. Patients with different ejection fractions were matched 1:2 using propensity score matching. Factors associated with short-term outcomes were determined using logistic regression and Kaplan-Meier survival analyses for the differences of all-causes death were generated.

Results: The 2 propensity score-matched groups consisted of 40 LVD (left ventricular dysfunction) and 120 NLVF (normal left ventricular function) patients, respectively. There were no statistical differences in the postoperative outcomes between groups except for the occurrence of left heart failure (22.5% in LVD vs. 5.0% in NLVF, p =0.009). Age (OR=1.11, 95%CI: 1.04-1.18) but not the preoperative left ventricular ejection fraction was shown in logistic regression to be a strong predictor of experiencing short-term events. Kaplan-Meier curves displayed a similar freedom from all cause death (p =0.119) or cardio-death (p =0.092) between groups.

Conclusion: The immediately outcomes post-operation and the long-term outcomes between groups are similar, indicating that OPCAB is a safe and effective choice for left ventricular dysfunction patients.

Keywords:

Off-pump coronary artery bypass surgery; Left ventricular dysfunction; Long-term outcomes; Propensity Score Matching

Introduction

The prevalence of coronary artery disease is rapidly increasing [1]. In China, the prevalence is estimated at 4.6 per thousand residences of all ages, effecting 5 million adults [2]. Coronary artery disease is the most major cause of left ventricular dysfunction, commonly defined in terms of reduced left ventricular ejection fraction (<50%) [2-4]. Coronary artery bypass graft (CABG) is the common type of cardiac surgery worldwide. Paradoxically, there is strong evidence from recent studies that left ventricular dysfunction is a predictor of early mortality and a leading cause of high healthcare cost after conventional coronary artery bypass grafting (cCABG), posing a great burden on both patients and society [5, 6].

Despite advances in surgical techniques, the management of patients with decreased left ventricular ejection fraction is still challenging. Off pump coronary artery bypass surgery (OPCAB) is an attractive alternative in patients with impaired left ventricular function, comparing with cCABG. The benefits of OPCAB theoretically were centered around the avoidance of cardiopulmonary bypass and aortic manipulation, which were endorsed by observations of avoiding the negative effects of cardiopulmonary bypass on markers of inflammation, coagulation, micro-embolization, thermoregulation, acid based balance, and regional perfusion [7-9]. Substantially, positive short- and middle- term outcomes of reducing morbidity and mortality were observed in study [10, 11]. In light of these advantages, OPCAB now accounts for more than 50% of all CABG operations in China and other developing countries [12].

However, lifting and rotating the heart during OPACB potentially alter such hemodynamics as left ventricular end-diastolic pressure, right atrial pressure and cardiac outputs, as a result of the worsened preservation of interventricular septal movement, the activation of inflammatory mediators and the non-physiologic ventricular geometry of the empty heart impeding collateral flow to ischemic areas [13]. The decrease in short-term mortality seen with OPCAB may be negated by reduced long-term graft patency, increased needs for repeat revascularization procedures and inferior long-term survival compared with CCAB in left ventricular dysfunction patients [14]. The clinical evidence base surrounding OPCAB in this population remains equivocal, ridden with biased observational studies, and relatively small randomized trials [15]. Given these concerns, it may seem still challenging for surgeons to take OPCAB procedure in patients with left ventricular dysfunction.

To address some of the evidence gaps regarding prevailing practices in management of patient with left ventricular dysfunction, we conducted present study to compare the short and long-term outcomes in patients with different ejection fractions undertaken OPCAB by the same surgeons team, using the real-life registry database with an analysis of a propensity score matching.

Materials and Methods

Study Design and Subjects

This was a retrospective, matched cohort study using data from the Hua-Shan Cardiac Surgery Registry. The consecutive coronary artery disease patients aged [?] 18 years who were underwent OPCAB procedures between 01 January 2016 and 31 December 2019 were enrolled. OPCAB were performed by one fully trained cardiac surgeon team, whose members had already performed a minimum of 50 off-pump operations. To be included, eligible patients had to have continuous medical record during preoperative, intraoperative and postoperative period. Patients were excluded if they were unable to understand given information or were reluctant to participate, had resection of ventricular aneurysm or re-do cardiac surgery, were technically not feasible for OPCAB, and had other logistic reasons that made routine follow up impossible.

Preoperatively, patient demographics were recorded. Patients were divided into two cohorts determined by left ventricular ejection fraction using the transthoracic echocardiogram: the left ventricular dysfunction (LVD) cohort consisted of those who had LVEF<50%, and the normal left ventricular function (NLVF) cohort included patients had LVEF[?]50%. Intraoperative variables were documented for all cohorts. All the eligible patients were periodically followed by on-site visit, telephone call or mailed questionnaire up to 31 June 2020. During on-site follow up, the computed tomographic angiography (CTA) or digital subtraction angiography (DSA) were used to assess the graft and echocardiography were used to measure the ventricular chamber size and LVEF. The blood pressure, lipid profile and blood glucose level of patients, which were directly associated with middle and long-term outcomes of grafts, were monitored. Patients reported events of clinical interest were collected and assessed systematically during follow up stages.

The present study was approved by the Ethic Committee of Hua Shan Hospital and conducted in concordance with Good Clinical Practice.

Operative Interventions

Off-pump coronary artery bypass operations for both cohorts were followed the standard care and processes of Hua Shan Hospital. In brief, after general anesthesia and well prepared mechanical circulatory support (both intra-aortic balloon pumps and extra-corporal circulation units), patients were performed conventional median sternotomy incision with harvesting of the left internal thoracic artery. Right internal mammary artery and/or radial artery and saphenous vein graft was performed as needed. Heparin was given at a low dose of 1 mg/kg to achieve a target activated clotting time (ACT) of at least 280s before ligation of the distal internal thoracic artery. The strategy of grafts was decided after the pericardium opened and the size of target vessels and heart assessed. Temporary stabilization of the target vessel achieved by an Octopus tissue stabilizer (Medtronic, Inc., Minneapolis, MN, USA) and if necessary supported with a deep pericardial traction suture. Intraluminal shunts (ClearView Intracoronary Shunt; Medtronic) and a blower mister (Guidant, Indianapolis, IN, USA) with carbon dioxide and warm isotonic sodium chloride were used to remove blood from the sites of arteriotomy and obtain a clear surgical field. An appropriately sized intra-coronary shunt was placed to maintain perfusion of the dependent myocardium and distal anastomosis performed using 7-0 polypropylene. Proximal anastomosis was done, if needed, using a partial occluding vascular clamp on the ascending aorta, an aortomoy punch and 5-0 polypropylene. Ultrasounds were routinely used to measure the patency and the flow of anastomosed grafts.

Definition of Variables

The binary endpoints: middle-term mortality, first confirmed occurrence of all cause death and cardio-death in relation to LVEF were evaluated. Major cardiovascular disease included heart failure, angina, myocardial infarction, atrial fibrillation and revascularization. Postoperative respiratory failure was defined as prolonged ventilation for more than 72h resulting from respiratory causes, newly developed pulmonary edema, adult respiratory distress syndrome, re-intubation due to respiratory causes and tracheostomy.

Statistical Analysis

Statistical analysis was performed using SPSS version 23 (IBM Corp., USA). Quantitative variables were expressed as means ± standard deviation (SD) or medians and Interquartile Range [IQR, (25th percentile, 75th percentile)]. Categorical variables were reported as numbers and percentages. Preoperative, intraoperative and postoperative patients' characteristics were analyzed descriptively and compared among cohorts with between-cohort differences assess using chi-squared tests or Fisher's exact test for categorical variables and Wilcoxon rank-sum tests for the continuous variables both before and after matching.

Propensity score matching was then used to mitigate underlying differences in covariates between the cohorts, and a multivariable logistic regression was used to build the propensity score model. Module of Propensity score matching for SPSS (Version 3.0.4) was used. All variables were retained in formulating the propensity score regardless of statistical significance because they were believed to be clinically relevant. Upon the estimation of propensity score, a greedy matching algorithm matched the LVD cohort to NLVF cohort 1:2. To ensure pairs were precisely matched on important covariates, the following variables were exact-matched: age groups (<60 years vs [?]60 years) and gender. Only patients with complete data sets were used in the creation of the propensity score.

Kaplan-Meier analysis was then used to estimate time to all cause death and cardio-death in LVD cohort versus NLVF cohort. To account for pairing, between-cohort differences were assed using partial likelihood ratio tests. Next, the number and proportion of patients who experienced major cardiovascular disease within the follow up period was estimated, and between-cohort differences were calculated using McNemar's test.

Multivariable Cox proportional hazard regression analysis was used to quantify the relative risk of mid-term mortality in the LVD cohort versus the NLVF cohort, controlling for covariates and stratified by matched pairs. Statistical significance was accepted as a two-sided test with an alpha level of 0.05.

Results

Study Population and Preoperative Characteristics

A total of 307 patients underwent OPCAB were enrolled and stratified by LVEF before matching. The two propensity score-matched groups consisted of 40 LVD and 120 NLVF patients, respectively. The demographic and preoperative characteristics of the patients both pre- and post-matching are shown in Table 1. Compared with LVD group, the NLVF group had significantly smaller proportion of smoker (34.9% vs. 51.9%;p =0.028), preoperative IABP (5.1% vs. 25.0%,p <0.001) and NYHA functional class III/IV (22.4% vs. 61.5%, p <0.001) before matching.

The matched-pairs had similar baseline characteristics expect for the baseline LVEF, which was higher in the NLVF group (62.8+-6.70% vs. 35.8+-5.98%, p<0.001), indicating that the propensity model had successfully served to remove the imbalance in distribution of a number of prognostic factors. Patients with normal LVEF had slightly higher proportion of obesity and CCS class3/4 angina compared to patients in NLVF group, but no significant difference were found (48.8% vs. 40.0%, 22.5% vs.17.5%, both p >0.05).

Intraoperative Characteristics and In-hospital Outcomes

Procedural characteristics (including emergent surgery and the number of distal anastomosis) were also balanced between the 2 matched groups. Complete revascularization was achieved in more than 80% of the patients. Inotropes were more widely used in LVD group (30.0% vs.13.8%, p =0.048). 77.5% of patients in the LVD group and 92.5% of patients in NLVF group were constructed three or more distal anastomoses (with a single vein graft) (p =0.037). Intraoperative characteristics and early postoperative morbidity and mortality were reported in Table 2. Patients in LVD group experienced significantly higher prevalence of left heart failure than NLVF group (22.5% vs. 5.0%, p =0.009). Despite higher postoperative major cardiovascular disease and surgical wound infection rates in the LVD group compared to the NLVF group, the difference did not reach statistical significance. There were no statistical differences in the postoperative occurrence of atrial fibrillation. There were no cases of perioperative MI, TIA or CVA in both groups. The in-hospital mortality was found to be similar before and after matching the preoperative characteristics. The lower LVEF was associated with longer ventilation, but the needs for ventilation more than 24h and/or respiratory failure were similar. The medical resource utilization (length of ICU and hospitalization stay) was similar in matched-pairs. Factors associated with short-term outcomes (all causes in-hospital death, major cardiovascular events or reoperation for bleeding) were assessed in the multivariate logistic regression model. Table 3 shows the OR estimates for predictors of short-term events in matched pairs. Importantly, age (OR=1.11, 95%CI: 1.04-1.18) but not the preoperative left ventricular ejection fraction (OR=0.99, 95%CI: 0.96-1.02) was shown to be a strong predictor of experiencing short term events.

Long-term survival and outcomes

A total of 209 patients the 2 groups (41 in LVD and 168 in NLVF), accounting for 68.1%, completed the planned follow-up. The median duration of the observed period were 42.8 months (range: 0.2 to 81.5 months) in the matched LVD cohort and 43.6 months (range: 0.1 to 80.9 months) in the matched NLVF cohort. During follow up period, 11 patients in LVD cohort and 11 patients in NLVF cohort died, with the long-term survivals of 72.5% and 90.8%, respectively. Of them, 7 patients in LVD cohort and 9 patients in NLVF cohort were cardiac death. The Kaplan Meier survival estimates at one-, three- and five-years for LVD cohort were 97.5%, 81.8% and 68.3%; while those for NLVF cohort were 97.5%, 88.2% and 79.5%. The 5-year freedoms from cardiac death were 74.8% and 86.3% in LVD and NLVF cohort respectively (Figure 2). As shown in Figure 1 and Figure 2, Kaplan-Meier curves displayed a similar freedom from all cause death ($\chi^2 = 2.431$,p =0.119) or cardio-death ($\chi^2 = 2.844$,p =0.092) between the two groups.

Discussion

To the best of our knowledge, this study provides an up-to-date and unique view of the association between preoperative LVEF and long-term outcomes in patients after OPCAB surgery. In present study, we performed a propensity score matching using a single-center surgery registry data to investigate the disparities of long-term survival between LVD and NLVF group, and the main findings of our study were as follows: 1) The proportion of perioperative inotrope usage were significantly greater in LVD group than NLVF patients, while the proportion of constructed three or more distal anastomoses were more in NLVF group, indicating the surgery management was more challenging for LVD patient intra-OPCAB; 2) the risk of post-operative left heart failure was higher in LVD patient, compared with NLVF patients, and 3) both early postoperative and long-term outcomes are similar regardless of preoperative LVEF. These findings confirm the efficacy and safety of OPCAB utilization in patients with reduced left ventricular ejection fraction. Furthermore, these findings highlight the importance of initiatives to develop a tailored surgery strategy for patients with LVD that is able to improve surgical outcomes and optimize the long-term survival.

With the highly prevalent of coronary artery disease globally, and increasing of comorbid with impaired LVEF, cardiac surgeons are facing more patients with poor pre-condition. LVEF is the most widely used clinical indicator of left ventricular systolic function and related the cardiovascular risk in patient with heart failure. Results from CHARM showed the risk of all-causes mortality and major cardiovascular event were inversely and linearly associated with LVEF [16]. The risk of stroke was more than doubled in patients with LVEF<15% [17]. OPCAB surgery avoids ischemic cardiac arrest during coronary artery revascularization. A recent published study shows that OPCAB is a safe and efficient choice for high risk patients with multiple organs failure [18]. Given the improvement and advantages of OPCAB procedure, more and more surgeons try to extend the suegery to high risk patients, including female and Low LVEF patient [19, 20].

Despite enthusiasm for OPCAB on the part of surgeons, widespread adoption in China has been slower than anticipated. It is due, in part, to a lack of definitive evidence whether OPCAB can be safe in LVD patients. In a recent randomized control study, OPCAB and on-pump techniques seemed to produce equivalent results, although OPCAB was associated with a lower graft patency rate [21]. Given the inconsistency of different report, the usage of OPCAB in LVD patients is limited in real practice.

The major concern is high proportion of completed revascularization, which reported to be an independent risk for all-cause mortality (HR=1.8) [22]. ROOBY study and a meta-analysis demonstrated that number of constructed distal anastomoses underwent OPCAB are lesser than those underwent conventional CABG [14, 23]. Our study is in line with above findings: the lower LVEF, the smaller proportion of constructed 3 or more distal anastomoses (77.5% vs 92.5%,p =0.037). Meanwhile, the occurrences of complete revascularization are not significantly different between groups (82.5% vs 87.5%, p =0.579). Preoperative IABP and using vascular shunt during operation to construct distal anastomoses can help patients with reduced LVEF to complete revascularization. Our results have significant implications for clinical practice. OPCAB can be safely undergone for patients with left ventricular dysfunction if well preoperative and intraoperative management. Surgeons should attempt to personalized management strategy for those patients.

Limitations

The present study has several limitations. First, as a single site study, the conclusion may not be applicable in general because of difference in practice patterns. Second, patients were not randomly assigned to either group. Therefore, selection bias may affect our findings. To mitigate the effect of this selection bias on outcomes, propensity score matching was used to identify well matched LVD and NLVF patients for comparison. Third, the size of our cohorts are somewhat small for comparison, but the statistical power of the analysis of operative outcomes, which was performed to determine whether there was enough power in this model. Last, incomplete follow up may bias our results when patient who drop out are different from those who complete follow-up. We have minimized this bias by incorporating innovative prevention and retention strategies (such as proactive social media interaction) into our design and implementation. We performed a structured survey by telephone interview in patients who were lost to follow-up to address this issue.

Conclusions:

Despite of more challenging on LVD patients' management, the immediately outcomes post operation, and the long-term outcomes are similar between groups are similar, indicating that the OPCAB is as safe and effective as conventional CABG in all patients, regardless of LVEF. Recognition of the safety of OPCAB in impaired LVEF patients can support the development of comprehensive choices for LVD patients' cardiac surgeries. More longitudinal studies are needed to assess the safety of OPCAB in real-world setting and to tailor interventions for LVD patients accordingly.

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Figure Legend

Figure 1. Kaplan-Meier Curve for Long-term Survival Post-OPCAB Surgery

Figure 2. Kaplan-Meier Curve for Freedom from Cardiac Death Post-OPCAB Surgery

Table 1. Preoperative Characteristics Stratified by LVEF

	Pre-matching	Pre-matching	Pre-matching	Post-matching	Post-matching	Post
	LVD (n=52)	NLVF (n=255)	p	LVD (n=40)	NLVF (n=80)	p
Age (years), mean±SD	66.0±9.15	67.0±9,51	0.167	68.0±7.11	69.1±8.45	0.47
60 years	76.9% (n=40)	72.5% (n=185)	0.607	85..0% (n=34)	85.0% (n=34)	0.99
Female	13.5% (n=7)	20.0% (n=51)	0.334	12.5% (n=5)	12.5% (n=10)	0.99
BMI (kg/m2), mean±SD	24.2±3.43	24.2±2.93	0.335	23.5±2.77	24.0±2.73	0.36

	Pre-matching	Pre-matching	Pre-matching	Post-matching	Post-matching	Post
>24kg/m2	48.1% (n=25)	51.8% (132)	0.651	40.0% (n=16)	48.8% (n=39)	0.43
LVEF (%), mean±SD	35.3±5.87	62.9±6.93	0.002	35.8±5.98	62.8±6.70	<0.0
Current Smoker	51.9% (n=27)	34.9% (n=89)	0.028	47.5% (n=19)	38.8% (n=31)	0.43
COPD	11.5% (n=6)	10.6% (n=27)	0.808	12.5% (n=5)	11.3% (n=9)	0.99
Hypertension	63.5% (n=33)	74.1% (n=189)	0.083	67.5% (n=27)	78.8% (n=63)	0.18
Dyslipidemia	11.5% (n=6)	12.2% (31)	0.999	12.5% (n=5)	15.0% (n=12)	0.78
History of myocardial infarction						
Atrial fibrillation	9.6% (n=5)	2.7% (n=7)	0.036	2.5% (n=1)	2.5% (n=2)	0.99
Diabetes mellitus	34.6% (n=18)	29.8% (n=76)	0.298	35.0% (n=14)	30.0% (n=24)	0.67
Previous PCI	11.5% (n=6)	8.6% (n=22)	0.596	12.5% (n=5)	12.5% (n=10)	0.99
History of TIA or CVA	32.7% (n=17)	43.9% (n=112)	0.165	30.0% (n=12)	42.5% (n=34)	0.23
NYHA functional class III/IV	61.5% (n=32)	22.4% (n=57)	<0.001	60.0% (n=24)	60.0% (n=48)	0.99
CKD	5.8% (n=3)	3.1% (n=8)	0.405	5.0% (n=2)	2.5% (n=2)	0.60
CCS class 3/4 angina	17.3% (n=9)	14.5% (n=37)	0.670	17.5% (n=7)	22.5% (n=18)	0.63
Left Main Lesions	34.6% (n=18)	39.6% (n=101)	0.536	40.0% (n=16)	38.8% (n=31)	0.99
Triple vessels disease	80.8% (n=42)	80.4% (n=205)	0.999	75.0% (n=30)	77.5% (n=62)	0.82
Preoperative IABP	25.0% (n=13)	5.1% (n=13)	<0.001	12.5% (n=5)	12.5% (n=10)	0.99

LVEF, left ventricular ejection function; SD, standard deviation; BMI, body mass index; LVEF, left ventricular ejection function; COPD, chronic obstructive pulmonary disease; PCI, percutaneous coronary intervention; TIA, transient ischemic attack; CVA, cerebrovascular attack; NYHA, New York Heart Association; CKD, chronic kidney disease; CCS, Canadian cardiovascular society. Data are expressed as % (n) unless otherwise indicated.

Table 2. Intraoperative Characteristics and Early Postoperative Outcomes Stratified by LVEF

	Pre-matching	Pre-matching	Pre-matching	Post-matching	Post-matching	Post-matching
	LVD (n=52)	NLVF (n=255)	p	LVD (n=40)	NLVF (n=80)	p
Intraoperative Characteristics						
Complete Revascularization	82.7% (n=43)	87.1% (n=222)	0.383	82.5% (n=33)	87.5% (n=70)	0.579
Number of distal anastomoses[?]3	82.7% (n=43)	88.2%(n=225)	0.261	77.5% (n=31)	92.5% (n=74)	0.037
Usage of LIMA	76.9% (n=40)	72.9% (n=186)	0.608	77.5% (n=31)	73.8% (n=59)	0.823
Inotrope usage	32.7% (n=17)	8.2% (n=21)	<0.001	30.0% (n=12)	13.8% (n=11)	0.048
Early Post-operative Outcomes						
In-hospital death	1.9% (n=1)	1.6% (n=4)	0.999	2.5% (n=1)	1.3% (n=1)	0.999
Major cardiovascular events	42.3% (n=22)	33.3% (n=85)	0.264	42.5% (n=17)	32.5% (n=26)	0.316

	Pre-matching	Pre-matching	Pre-matching	Post-matching	Post-matching	Post-matching
Perioperative myocardial infarction	0	0.4% (n=1)	0.999	0	0	N/A
TIA or CVA	3.8% (n=2)	3.1% (n=8)	0.680	0	0	N/A
Atrial fibrillation	34.6% (n=18)	29.8% (n=76)	0.511	32.5% (n=13)	30.0% (n=24)	0.835
Left heart failure	19.2% (n=10)	6.7% (n=17)	0.012	22.5% (n=9)	5.0% (n=4)	0.009
Surgical wound infection	3.8% (n=2)	2.0% (n=5)	0.338	5.0% (n=2)	2.5% (n=2)	0.600
Re-intbation	5.8% (n=3)	3.1% (n=8)	0.405	5.0% (n=2)	6.3% (n=5)	0.999
Reoperation for bleeding	0	2.7% (n=7)	0.607	0	6.3% (n=5)	0.168
Blood Loss (ml, first 24h), median (IQR)	505 (275, 810)	435(282.5, 602.5)	0.028	530(275, 888.8)	390(260, 622.5)	0.103
ICU LOS (hour), median (IQR)	13.8 (8, 18.6)	8 (6, 16)	0.304	13(7.5, 18)	8.5 (6.2, 17.1)	0.977
Ventilation (hour), median (IQR)	13.38 (7.5, 17.5)	8 (5.8, 15.5)	0.334	13(7.4, 17)	8.1(6, 16)	0.995
Prolonged ventilation (>24 hours)	9.6% (n=5)	3.5% (n=9)	0.068	10.0% (n=4)	10.0% (n=8)	0.999
Hospitalization LOS (day), median (IQR)	6 (6, 10)	6 (6,7)	0.166	6(6,10)	6(6, 7.3)	0.078

LVEF, left ventricular ejection function; IABP, intra-aortic balloon pump; SD, standard deviation; LIMA, left internal mammary artery; TIA, transient ischemic attack; CVA, cerebrovascular attack; LOS, length of Stay. Data are expressed as n (%) unless otherwise indicated.

Table 3. Independent predictor for short-term events in multivariable logistic regression models

Variables	OR (95%CI)	p
Gender(male vs. female)	0.859(0.229, 3.215)	0.821
Age ([?]60 years vs. <60 years)	1.107(1.038, 1.181)	0.002
BMI (>24kg/m^2 vs. [?] 24kg/m^2)	1.080(0.914, 1.275)	0.368
Hypertension (yes vs. no)	0.711(0.249, 2.029)	0.523
Diabetes (yes vs. no)	0.463(0.168, 1.277)	0.137
Current smoker (yes vs. no)	1.003(0.385, 2.613)	0.995

Variables	OR (95%CI)	p
Dyslipidemia (yes vs. no)	0.476(0.108, 2.107)	0.328
COPD (yes vs. no)	0.550(0.126, 2.397)	0.426
Previous PCI (yes vs. no)	2.380(0.667, 8.498)	0.182
NYHA function class III/IV (yes vs. no)	1.147(0.458, 2.872)	0.770
History of TIA or CVA (yes vs. no)	1.224(0.475, 3.158)	0.676
Triple vessels diseases (yes vs. no)	0.992(0.383, 2.568)	0.987
LVEF ([?]50% vs. $<$50%)	0.985(0.955, 1.017)	0.353

CI, Confidence Interval; BMI, Body Mass Index; COPD, Chronic obstructive pulmonary disease; PCI, percutaneous coronary intervention; NYHA, New York Heart Association; TIA, transient ischemic attack; CVA, cerebrovascular attack; LVEF, left ventricular ejection fraction.

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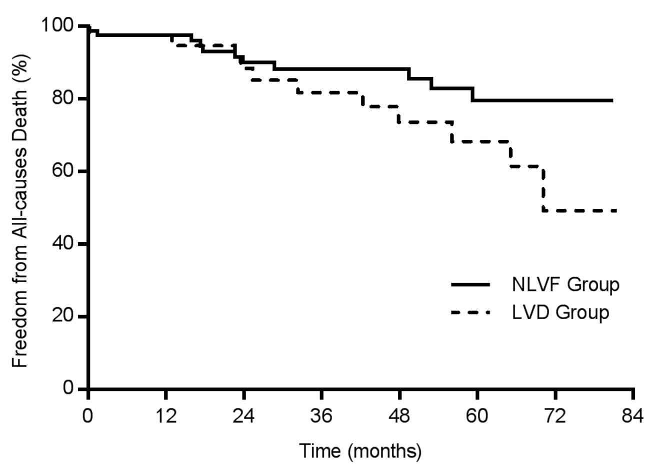
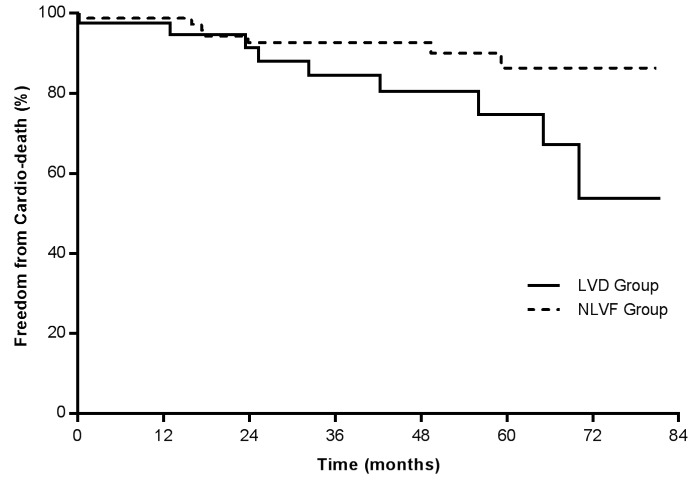


Number of Subjects at Risk:

NLVF:	80	73	57	46	38	20	12
LVD:	40	38	29	23	18	11	5



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