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Outcome of Elective Coronary Artery Bypass Grafting Surgery in Patients with Low LV Ejection Fraction

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Abstract

Background: Elective coronary artery bypass grafting (CABG) is one of the most common heart surgeries performed recently. Among cardiac surgery patients, low preoperative left ventricular ejection fraction (LVEF) is common and has been associated with poor outcomes.

Aim of Study: The aim of this study was to compare the postoperative outcome of coronary artery bypass grafting with low ejection fraction versus good ejection fraction.

Patients and Methods: This research is a prospective, controlled randomized clinical trial involving 150 patients who are eligible for CABG. After appropriate consent from enrolled patients and local ethical committee, current study done on 50 consecutive adult patients with severe ischemic heart disease and low ejection fraction <40% (patient group) and 100 patients with an EF >40% (control group), scheduled for elective Coronary Artery Bypass Grafting (CABG) as a study in Galaa Medical Compound for Armed Forces between April 2021 and March 2023.

Results: There was significant prolonged cardiopulmonary bypass (CPB) time in low EF patient (153.95±36.73 minutes) compared to normal EF patients (138.56±40.71 minutes) (*p*=0.026) with insignificant prolongation of aortic cross clamp (86.93+22.23 minutes) and total operative times (338.6±91.16 minutes) in patient group compared to (86.70±27.84 and 309.5±89.61 minutes) respectively in those with normal EF patients (*p*>0.05). Patients with low EF% (patient group) were statistically significant difficulty weaning from CPB compared to those with normal EF (control group) (*p*<0.001). Seven cases (16.7%) versus one (1.2%) weaned by IABP, ten cases (23.8%) versus one (1.2%) by combined support and two difficult (4.8%) weaning compared to no cases in patients and control groups respectively. The higher statistically significant levels of CK-MB (137.08 vs 90.75 U/L; *p*=0.000), prolonged ventilation times (35.60 vs 11.63 hours; *p*=0.000), ICU stays (3.72 vs 2.40 days; *p*=0.000) and hospital stays (12.65 vs 10.29 days; *p*=0.023) in patient group with low EF% compared to those with normal EF% respectively. Troponin I levels were statistically significant higher at induction (0.48 vs 0.23 ng/mL *p*=0.000), 2 hours (4.99 vs 3.94 ng/mL p=0.020), 12 hours (6.66 vs 5.25 ng/mL *p*=0.011), 24 hours (3.70 vs 2.84 ng/mL *p*=0.006) and 48 hours (1.73 vs 1.32 ng/mL *p*=0.006) postoperatively in patients with EF<40% compared to those with normal EF% (control group) respectively with a peak levels after 12 hours in both groups. Patients with low EF% (patient group) have statistically significant higher usage of IABP (40% intraoperative and 4% in ICU) compared to those with normal EF% (control group) (3% intraoperative and 3% in ICU) (*p*<0.001). Patients with low EF% (patient group) have statistically significant higher consuming postoperative inotropes (74%) compared to 31% in those with normal EF% (control group) (*p*=0.000). There was insignificant increased of mortality rate among patient group (8%) compared to control group (3%) (*p*=0.171).

Conclusions: CABG in patients with EF <40% is frequently associated with more complications than others with normal ejection fraction. In addition, cardiopulmonary bypass time and the use of IABP is also dependent on the preoperative ejection fraction. Patients with low EF% were difficulty weaning from CPB compared to those with normal EF.

Key Words: *Elective coronary artery bypass grafting surgery – Low LV ejection fraction.*

Introduction

CORONARY artery disease (CAD) is the most frequent cause of death globally and the most common cause of heart failure (HF) over world. The incidence of left ventricular dysfunction (LVD) is increasing among patients with CAD in part because of improved survival after acute myocardial infarction (MI). However, the long-term prognosis for this condition remains poor **[1]**.

Cardiac surgery improves survival in patients with advanced left ventricular dysfunction by comparison with medical treatment. In contrast, the

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negative impact of low preoperative left ventricular ejection fraction (LVEF) in the outcomes after any type of cardiac surgery has long been well documented [2].

Despite improvements in medical therapy and surgical techniques, management of patients with left ventricular (LV) dysfunction and coronary artery disease undergoing cardiac surgery is still challenging. Coronary artery bypass grafting (CABG) has appeared to be superior to medical therapy alone for patients with low ejection fraction (EF), representing a significant clinical improvement and long-term survival. For these patients, CABG is associated with higher postoperative morbidity and mortality rates compared with patients with normal EF [3].

The low EF patients undergoing CABG are the subjects of ongoing research. The studies investigating early postoperative changes have yielded conflicting results. Some have found ventricular improvement within weeks postoperatively [4], while other studies have detected no change [5] or a worsening of ventricular function [6,7].

Aim of the work:

The aim of this work was to compare the postoperative outcome of coronary artery bypass grafting with low ejection fraction versus good ejection fraction.

Patients and Methods

This randomized controlled study done on 50 consecutive adult patients with severe ischemic heart disease and low ejection fraction <40% scheduled for elective Coronary Artery Bypass Grafting (CABG) as a study in Al-Galaa Medical Compound for Armed Forces. The control group composed of 100 patients with an EF >40%, presenting with the same coronary pathology and scheduled for elective CABG at the same hospital between April 2021 and March 2023.

Ethical aspects:

This study was carried out in complete accordance with the Declaration of Helsinki's ethical principles, good clinical practice recommendations, and all relevant local regulatory requirements. Our study procedure was authorized by the local Ethical Committee of Ain Shams University's Institute of Postgraduate Studies. All mentally competent patients provided written informed permission prior to participating.

Inclusion criteria:

This study will include adult patients of both sexes either have diabetes or hypertension presenting for elective coronary artery bypass grafting with normal coagulation profile (PT, PTT, INR) and serum creatinine <2.2.

Exclusion criteria:

- Patients with left main disease (LM).
- Patients with ejection fraction <25%.
- Patients with combined cardiac procedure (combined valves or surgery on aorta).
- Patients with previous cardiac surgery (REDO).
- Patients with chronic renal failure on dialysis.
- Patients with uncontrolled DM.

Research data items:

Clinical data:

1- Preoperative:

Patient's data including age and sex, complaint and history of associated comorbidities, full laboratory investigations: Hemoglobin (g/dL), creatinine (mg/dL), albumin (g/dL), CK-MB (U/L), prothrombin time and INR, Partial thromboplastin time (sec.), ECG changes (ischemic changes, old MI, AF or LBBB.......), plain chest X-ray findings.

2- Intra operative (procedure):

Surgical procedures: Technique (On pump or Off pump).

Cardiopulmonary bypass (CPB) procedures: Total time of CPB, time of cross clamp, weaning from bypass (smoothly, with chemical support, on IABP, DC shock, on pacemaker, difficult weaning), total time of the operation.

3- Post-operative:

Primary outcome:

Markers of ischemia: Troponin I: Serial venous blood samples were taken after induction of anesthesia, 2 hours, 12 hours, 24 and 48 hours after aortic unclamping in on-pump cases and after termination of the last distal anastomosis in off pump cases. Troponin I measured by VITROS ECIQ immunodiagnostic system, CK-MB .

ICU support: Mechanical (IABP, ventilator), chemical support (Inotropes), blood & fluids.

Secondary outcome:

ICU morbidities: Cardiovascular (Chest drainage, arrhythmias), neurological sequel, fever & infection. ICU mortality, ICU stay, hospital stay.

Statistical analysis:

All tests were bilateral and a *p*-value of 5% was the limit of statistical significance. Analysis performed by statistical package software IBM-SPSS version 24. Values were presented as median (range) for quantitative variables or as numbers and proportions for qualitative variables. Significant *p*-values <0.05 while non-significant *p*-values >0.05.

Results

Table (1) showed that patients with low EF% (patient group) were statistically significant difficulty weaning from CPB compared to those with normal EF (control group) (p<0.001). Seven cases (16.7%) versus one (1.2%) weaned by IABP, ten cases (23.8%) versus one (1.2%) by combined support and two difficult (4.8%) weaning compared to no cases in patients and control groups respectively.

Table (2) showed higher statistically significant levels of CK-MB (137.08 vs 90.75 U/L; p=0.000), prolonged ventilation times (35.60 vs 11.63 hours; p=0.000), ICU stays (3.72 vs 2.40 days; p=0.000) and hospital stays (12.65 vs 10.29 days; p=0.023) in patient group with low EF% compared to those with normal EF% respectively. While the man number of blood transfusion units was insignificant increased in patient group (2.45 units) compared to control group (2.25 units) (p=0.589).

Table (3) showed statistically significant higher troponin I levels at induction (0.48 vs 0.23 ng/mL p=0.000), 2 hours (4.99 vs 3.94 ng/mL p=0.020), 12 hours (6.66 vs 5.25 ng/mL p=0.011), 24 hours (3.70 vs 2.84 ng/mL p=0.006) and 48 hours (1.73 vs 1.32 ng/mL p=0.006) postoperatively in patients with EF <40% compared to those with normal EF% (control group) respectively with a peak levels after 12 hours in both groups.

Table (4) showed that patients with low EF% (patient group) have statistically significant higher usage of IABP (40% intraoperative and 4% in ICU) compared to those with normal EF% (control group) (3% intraoperative and 3% in ICU) (p<0.001).

Table (5) showed that patients with low EF% (patient group) have statistically significant higher consuming postoperative inotropes (74%) compared to 31% in those with normal EF% (control group) (p=0.000).

Table (1): Weaning from CPB in studied groups.

	Patient group No=42		Control group No=82		Test	*p*-value
	Count	%	Count	%		
Smoothly	15	35.7	65	79.3	39.512	0.000
With chemical support	8	19.0	13	15.9		
IABP	7	16.7	1	1.2		
Combined support	10	23.8	1	1.2		
DC shock or pacemaker	0	0	2	2.4		
Difficult	2	4.8	0	0		

Table (2): Post-operative outcome in both studied groups.

	Patient group No=42		Control group No=82		Test	*p*-value
	Mean	SD	Mean	SD		
CK-MB (U/L)	137.08	84.05	90.75	66.69	3.536	0.000
Ventilation time (hours)	35.60	8.75	11.63	4.65	6.393	0.000
Blood (units)	2.45	1.95	2.25	1.74	0.540	0.589
ICU stay (days)	3.72	1.91	2.40	0.70	4.856	0.000
Hospital stay (days)	12.65	5.47	10.29	3.19	2.276	0.023

Table (3): Troponin levels at induction of anesthesia and after aortic unclamping or termination of last distal anastomosis in both study groups.

Troponin I (ng/ml)	Patient group No=50		Control group No=100		Test	*p*-value
	Mean	SD	Mean	SD		
At induction	0.48	0.45	0.23	0.30	3.540	0.000
After 2 hours	4.99	3.46	3.94	3.25	2.536	0.020
After 12 hours	6.66	3.80	5.25	3.31	2.536	0.011
After 24 hours	3.70	2.22	2.84	2.11	2.739	0.006
After 48 hours	1.73	1.13	1.32	1.15	2.733	0.006

Table (4): Intra-aortic balloon pump used in studied groups.

	Patient group No=50		Control group No=100		Test	*p*-value
	Count	%	Count	%		
No	28	56	94	94	36.779	0.000
Intraoperative	20	40	3	3		
ICU	2	4	3	3		

Table (5): Postoperative inotropes in studied groups.

	Patient group No=50		Control group No=100		Test	*p*-value
	Count	%	Count	%		
No	13	26	69	69	46.117	0.000
Levophed	17	34	27	27		
Adrenaline	0	0	2	2		
Levo and adr	12	24	2	2		
Levo and simdax	5	10	0	0		
Multiple	3	3	0	0		

Discussion

Left Ventricular Ejection Fraction (LVEF) indicates the efficiency of the ventricle and is regarded as an optimal marker of LV function. LVEF has been considered as among the strongest predictors of clinical outcomes after cardiac surgery [8].

Despite improvements in medical therapy and surgical techniques, management of patients with left ventricular dysfunction undergoing cardiac surgery is still challenging, although coronary artery bypass graft (CABG) surgery has shown superiority over medical therapy alone, leading to significant clinical improvement and long-term survival [9]. Nonetheless, it is not without risks. Presently, the all-cause mortality rate stands at 1% for patients with preserved ejection fraction (EF) [10].

However, patients with LVEF below 40% experience higher postoperative morbidity and mortality rates compared to those with normal LVEF. Notably, advances in patient selection, surgical techniques, and pre-operative optimization have contributed to improved CABG outcomes [11].

Regards to CABG techniques, recently both on-pump (ONCABG) and off-pump (OPCABG), were compared to seek the most effective approach to reduce the cost of prolonged intensive care unit length of stay and mortality [12]. OPCABG allows surgeons to perform bypass grafting while the heart is still beating, thereby avoiding cardiopulmonary bypass and its associated risks. The choice between on-pump and off-pump CABG remains controversial among cardiovascular surgeons and researchers. Numerous studies have investigated the outcomes and advantages of both techniques, leading to conflicting results. Some studies have reported comparable long-term survival rates, intensive care unit (ICU) length of stay, and perioperative mortality between on pump and off-pump CABG [13,14]. On the other hand, other studies have suggested potential benefits of one technique over the other regarding reduced complications and improved patient outcomes [15,16].

The choice between techniques depends on surgeon preference and patient characteristics [12]. Current study showed that nearly equal operative technique done to enrolled studied groups, where 42 (84%) of patients underwent on pump technique compared to 82 (82%) of control group, also 8 (16%) of patients underwent off pump technique compared to 18 (18%) of control group with no significant differences between them (p=0.760). Compared to current findings, Khalili et al. [17], Ponnuru et al. [18] and Ibrahim et al. [12] in their study, on-pomp CABG procedure was performed in 51.8%, 98.6% and 81.5% of patients respectively.

Generally, about 80% of CABG procedure are on-pump CABG in which the involvement of cardiopulmonary bypass (CPB) and aortic cross clamping plays a major role [11]. However, the non-physiologic nature of CPB in CABG provokes undesirable inflammatory response, resulting in myocardial injury through inflammation and ischemia-reperfusion mechanism [19]. These mechanisms result in organ dysfunction, major complications or in worst case, mortality [20]. Current study showed significant prolonged cardiopulmonary bypass (CPB) time in low EF patient (153.95±36.73 minutes) compared to (138.56±40.71 minutes) in normal EF patients (*p*=0.026) with insignificant prolongation of aortic cross clamp (86.93+22.23 minutes) and total operative times (338.6±91.16 minutes) in patient group compared to (86.70±27.84 and 309.5±89.61 minutes) respectively in those with normal EF patients (*p*>0.05). Similar results were found by Khaled et al. [3] in which CPB was prolonged (141.05±71.31 vs 127.24±62.15 minutes) and cross clamp times also prolonged (92.3±37.8 vs 90.0±40.8 minutes) in patients with EF%<35% and patients with EF% >35% respectively (*p*>0.05).

Compared to current study, Awan et al. [21] revealed insignificant differences between CPB and aortic cross clamp times; where patients with normal EF had (94.78±25.03 and 52.93±15.24 minutes), with mild to moderate EF had (97.83±25.78 and 54.08±16.83 minutes) and those with severely reduced EF had (95.84±20.78 and 51.26±15.88 minutes) respectively. Also, Ponnuru et al. [18] described average CPB time was 124.32±38.26 minutes and aortic cross-clamp time was 67.45±26.89 minutes. The CPB time in the study by Jose et al., was 105.86±27.97 minutes and the aortic cross clamp time was 50.82±17.35 minutes [22].

Due to prolonged CPB time, patients with low EF% (patient group) were statistically significant difficulty weaning from CPB compared to those with normal EF (control group) (*p*<0.001). Seven cases (16.7%) versus one (1.2%) weaned by IABP, ten cases (23.8%) versus one (1.2%) weaned by combined support and two difficult (4.8%) weaning compared to no cases in patients and control groups respectively. In agreement with our study, Khaled et al. [3], revealed significantly higher perioperative insertion of IABP (32%) and inotropic support (14%) in patients with low EF% compared to 16% and 1.3% respectively in patients with normal EF%. Similarly, Awan et al. [21] used IABP in 3.2% of normal EF, 15.1% of mild to moderate EF and 39% of severely reduced EF. Also, Ponnuru et al. [18] used IABP in 14 patients (9.6%) with higher consumption of postoperative inotropic support.

Regards to post-operative outcome in studied groups; current study showed higher statistically significant levels of CK-MB (137.08 vs 90.75 U/L; *p*=0.000), prolonged ventilation times (35.60 vs 11.63 hours; p=0.000), ICU stays (3.72 vs 2.40 days; *p*=0.000) and hospital stays (12.65 vs 10.29 days; *p*=0.023) in patient group with low EF% compared to those with normal EF% respectively. While the man number of blood transfusion units was insignificant increased in patient group (2.45 units) compared to control group (2.25 units) (*p*=0.589). This occurred due to EF <40% is associated with hemodynamic instability and the increased use of IABP and inotropes and these factors affected the duration of mechanical, ICU and hospital stay directly [23].

Compared to our study, Awan et al. [21], revealed that mean number of blood transfusions in low EF group was 0.64±0.48. 96.2% of the patients in severely reduced EF group underwent intra-operative and post-operative transfusions of blood products that included fresh frozen plasma, platelets and packed cells RBCs. In their study 2.9% of the patients in low EF group had prolonged ventilation, 5.6% of the normal EF group were re-opened within 48 hours post operatively for bleeding/tamponade. Complication of post-operative stroke during the hospital stay was highest in reduced EF group that is 1%, prolong ICU stay that is more than 48 hours was also common in same group (0.9%) discharge to home ratio was significantly lower in patients with reduced EF (91.4%).

Similarly El-Shafey et al. [4] revealed that the need for mechanical ventilation (17.99 vs 16.98 hours), ICU (3.75 vs 3.39 days) and hospital stay (8.85 vs 7.93 days) were significantly longer in low EF% compared to those with normal EF% respectively. While Ponnuru et al. [18] reported that the mean ICU stay duration was 4±3.3 days. The majority of patients (59.6%) had 3-5 days of ICU stay. The mean hospital stay duration was 10.6±6.0 days.

As any other type of cardiac surgery, CABG intervention can potentially cause periprocedural myocardial infarction (PMI) or myocardial injury, the latter one being defined as an isolated elevation of cardiac markers without clinical and/or instrumental signs of an ischemic etiology [24]. In this instance, the troponin I is proposed as a marker of choice after cardiac surgeries and it is a preferred marker in detecting myocardial necrosis and diagnosing myocardial infarction. Current study showed statistically significant higher troponin I levels at induction (0.48 vs 0.23 ng/mL *p*=0.000), 2 hours (4.99 vs 3.94 ng/mL *p*=0.020), 12 hours (6.66 vs 5.25 ng/mL *p*=0.011), 24 hours (3.70 vs 2.84 ng/mL p=0.006) and 48 hours (1.73 vs 1.32 ng/mL *p*=0.006) post-operatively in patients with EF<40% compared to those with normal EF% (control group) respectively with a peak levels after 12 hours in both groups.

Previous research by Kocak et al. [25] observed higher cardiac marker values between the pre-aortic and the post-aortic cross-clamping period. Furthermore, Kocak et al. [25] also observed the relationship between histopathological myocardial injury score and cardiac marker values after the aortic cross-clamping period. Their findings showed a significant positive correlation between the apoptotic index and CPB time and arterial blood cardiac troponin I in the post- aortic cross-clamping period.

A study conducted by Sufit et al. [26] reported serum concentration values of troponin I level peaking at 6 hours after aortic unclamping, and declining thereafter. Another study by Lomivorotov et al. [27] observed peak troponin I level at 6 hours after CPB in on-pump CABG surgeries.

Nanni et al. [24] evaluated the isolated high sensitive cardiac troponin (hs-cTn) concentrations in the first 24h following CABG and its relations to cardiac adverse events (in-hospital death and PMI) and/or left ventricular ejection fraction (LVEF) decrease. They showed that post-operative hs-cTn I is so sensitive that in the vast majority of patients undergoing CABG surgery have hs-cTn I absolute value within 48h after the intervention is superior to the limit required by the latest guidelines for the diagnosis of PMI. They observed the highest values at 9–12h after surgery as well as hs-cTn I values at 9–12h post-operatively was significantly higher in patients who suffered a low LVEF.

Recently Parmana et al. [11] analyzed the correlation between plasma troponin I (before induction, 5 minutes, 6 hours and 24 hours, 48 hours after CPB) and myocardial histopathology in low ejection fraction patients undergoing elective on-pump CABG. A fair positive correlation was observed between plasma troponin I level at 5 minutes and 6 hours after CPB and CPB duration in studied patients.

Due to prolonged CPB time and hemodynamic instability, the enrolled patients with low EF% (patient group) have statistically significant higher usage of IABP (40% intraoperative and 4% in ICU vs 3% intraoperative and 3% in ICU) (p<0.001) and higher consuming postoperative inotropes (74% vs 31%) (p=0.000) compared to those with normal EF% (control group). In a line with these results, He et al. [28] demonstrated in their study that patients who had low ejection fractions (EF <35%) had a higher rate of IABP application (25.8%) when compared to those with higher ejection fractions (EF 36-50%) (9.2%). Also, Awan et al. [21] revealed that history of myocardial infarction and use of IABP intra operatively was higher in severely reduced EF group compared to the patients with normal EF. IABP was used in 39% of patient with severely reduced EF which was higher as compared to the normal (3.2%) and moderately reduced EF (15.1%) groups. This may be due to variation in the thresholds for IABP amongst various centers [29].

Regards to postoperative CABG complication; current study revealed that lower EF% in patient group was associated with significant higher incidence (24%) of postoperative ICU morbidities (high chest drainage, arrhythmia, neurological, infection and multiple morbidities) compared to 11% in those with normal EF% (control group) (p=0.023). Similar to current findings, a national cohort study by Omer et al. [30] on 61,477 patients, 6586 (10.7%) had a perioperative complication and 2056 (3.3%) had multiple complications. Compared to LVEF ˃35%, decreasing ejection fraction was associated with greater odds of complications (25%-34%). Also in El-Shafey et al. [4] study, the major adverse cardiac events were higher in the group with EF <40% than group with EF ˃40 and non-fatal cerebrovascular events, non-fatal myocardial infarction, heart failure, infectious and neurological complications occurred more significantly in EF <40% patients. Against current study, Khaled et al. [3] revealed insignificant differences in postoperative complications (wound infection, neurological, AKI and reoperation for bleeding) between patients with EF >35% and those <35%.

CABG is commonly known to have higher operative mortality and reduced survival in patients with LVEF of less than 40% compared with those with normal ventricular function [17]. Over the years, with improvements in myocardial protection, anesthesia, cardiopulmonary bypass (CPB), and post-operative support, operative mortality in this group has significantly decreased [31]. The mortality rate in current study was insignificantly increased among patient group (8%) compared to control group (3%) (p=0.171). In a line with our results, El-Shafey et al. [4] reported that the mortality rate occurred in 8.3% of the patients with EF <40% which was slightly higher than the 2.0% in patients with EF >40%. AlsoAwan et al. [21], revealed that post-operative mortality was highest in patients with reduced EF group that is 8.6%, 5% in moderate EF group and 3% in normal EF group.

Recently Laimoud et al. [32] study included 410 patients divided into 4 groups: patients had LVEF less than 35%, LVEF 35–45%, LVEF 45–55% and LVEF more than 55% with significant differences in hospital mortality occurred in (6.7% vs. 0% vs. 0.9% vs. 3.5%, respectively with p=0.03).

Compared to current findings, Khaled et al. [3] revealed early mortality was 5.2% in patients with normal EF% and 5.8% in patients with low EF%, with a statistically insignificant difference. The causes of death were cardiogenic shock, multi-organ failure and respiratory insufficiency.

Also the mortality rate in the present work occurred in 8.3% of the patients was slightly higher than the reported series which ranged from 3.4% to 4.4% [33,34]. A review of 55,515 patients form a New York State Database who underwent CABG procedures between 1997 and 1999 reported a mortality rate of 4.6% in patients with EF ≤20%. A study that included patients with valve disease reported a mortality rate of 5.6% in patients with LVEF ≤40% [7].

Current result was lower than that reported by Cassar et al. [35], they described that patients with <40% EF had 9.3% perioperative mortality. Studies done by Christakis et al. [36] in patients with ≤25% EF there was 9.8% operative mortality, and Carr et al. [37] have shown 11% perioperative mortality in patients having EF <35%. Also, Di Carli et al. [38] reported a 30-day postoperative mortality rate of 9.3% in patients with EF <40%. However, a more recent report suggested a lower postoperative mortality rate. A review that compared the in-hospital mortality rates of patients undergoing CABG surgery noted that patients who had an EF <35% had a mortality rate that was six times higher than that of patients with EF >50%. Immediate mortality in patients with EF <35% was 10.5% *[39]*.

Other studies have reported a mortality rate of up to 20% in patients with heart failure undergoing CABG *[36,40]*. This may be due to lack of medical awareness, vigorously avoidance of surgery and more aggressive disease pattern which is reflected in their patient group and poor targets.

The improvement in the operative outcome of patients with poor left ventricular function is multifactorial. Lower incidence of mortality of our high-risk patients has been benefited from advances in peri- and postoperative managements of comorbid risk factors and myocardial protection strategies such as vasodilator therapy, cardioplegic infusion, use of the postoperative intra-aortic balloon, improved techniques of anesthetic induction, epi-aortic scanning, and intensive insulin therapy *[41]*.

Recently Omer and colleagues *[30]*, analyze data from more than sixty thousand patients included in the Veterans Affairs Surgical Quality Improvement Program database who had isolated CABG from 2000 to 2016, to evaluate the association between low LVEF (<35%), complication rescue, and long-term survival after isolated CABG. The authors found that decreased ejection fraction was associated with greater odds of complications and that there was a dose–response relationship between decreasing LVEF and overall risk of death. They clearly demonstrated that depressed LVEF was strongly associated with incremental rates of some complications (renal failure, prolonged ventilation, new mechanical support) and that the risk of specific complications may vary within LVEF classes according to other preoperative characteristics (ie, pre-existing renal failure or lung disease). Furthermore, they have shown that patients who were rescued from complications had decreased 10-year survival, regardless of LVEF.

Karedath et al. *[10]* recently in their meta-analysis; conducted to compare mortality in patients with reduced and preserved EF undergoing CABG. The pooled analysis of five studies showed that the rate of early and late mortality is significantly higher in patients with reduced EF compared to patients with preserved EF. Reduced EF signifies a diminished ability of the left ventricle to eject blood with each contraction, resulting in decreased cardiac output and compromised overall cardiovascular function. This impaired heart function is associated with a decreased ability to deliver sufficient oxygen and nutrients to meet the body's demands, particularly during periods of stress or increased workload, such as during surgery *[42]*. Additionally, patients with reduced EF often have a higher burden of comorbidities, such as myocardial infarction and other cardiovascular conditions, which can further exacerbate the risk of adverse outcomes following CABG *[43]*.

Conclusions:

CABG in patients with EF <40% is frequently associated with more complications than others with normal ejection fraction. In addition, cardiopulmonary bypass time and the use of IABP is also dependent on the preoperative ejection fraction. Patients with low EF% were difficulty weaning from CPB compared to those with normal EF.

Mean troponin I was statistically significant higher at induction, 2 hours, 12 hours, 24 hours and 48 hours postoperatively in patients with EF <40% than in those with normal EF% with a peak levels after 12 hours in both groups.

Current study demonstrated higher rate of mortality in patients with low EF, emphasizing the importance of EF assessment in risk stratification for CABG patients. Understanding the impact of low EF on surgical outcomes is crucial for better risk stratification and treatment planning in this unique patient cohort. With ongoing advancements in medical care and further research, we can strive to improve outcomes and quality of life for patients with low EF undergoing CABG.

Large, multi-center prospective studies with maintenance of a central registry for cardiovascular procedures are needed to evaluate and improve the morbidity and mortality associated with these procedures.

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نتائج عملية ترقيع الشرايين التاجية الاختيارية فى المرضى ذات ضعف كفاءة البطين الأيسر

المقدمـة: تعتبر عملية ترقيع الشرايين التاجية الاختيارية من أكثر الجراحات القلبية فى الأونة الأخيرة، ضعف كفاءة البطين الأيسر قبل الجراحة شائعًا ويرتبط بنتائج سيئة.

الهدف من الدراسة: مقارنة نتائج ما بعد الجراحة لعملية ترقيع الشرايين التاجية الاختيارية فى المرضى ذات ضعف كفاءة البطين الأيسر مقارنة بالمرضى ذات كفاءة جيدة للبطين الأيسر.

المرضى وطرق الدراسة: تمت الدراسة علي ١٥٠ مريض يعانون من مرض نقص تروية القلب الحاد فى مجمع الجلاء الطبي للقوات المسلحة بين أبريل ٢٠٢١ ومارس ٢٠٢٣. تم تقسيم المرضى إلى مجموعتين: مجموعة تضم ٥٠ مريضًا بالغًا مع ضعف كفاءة البطين الأيسر <٤٠، مجموعة الضابطة: وتضم ١٠٠ مريض مع كفاءة البطين الأيسر >٤٠.

النتائج: ارتفاع مستوى انزيمات القلب CK–MB وأوقات التهوية الصناعية والإقامة فى وحدة العناية المركزة والإقامة فى المستشفى فى مجموعة المرضى مقارنةً بالمجموعة الضابطة. كانت مستويات التروبونين I أعلى و ذات دلالة إحصائية فى المرضى الذين يعانون من ضعف كفاءة البطين الأيسر <٤٠٪ مقارنة مع أولئك الذين لديهم كفاءة البطين الأيسر طبيعى مع ذروة مستويات التروبونين بعد ١٢ ساعة فى كلا المجموعتين.

الاستنتاجات: أظهرت الدراسة الحالية ارتفاع معدل الوفيات لدى المرضى الذين يعانون من انخفاض كفاءة البطين الأيسر، مع التركيز على أهمية تقييم كفاءة البطين الأيسر فى التقسيم الطبقى للمخاطر لمرضى CABG.