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Comparison of Early Postoperative Complications between On-Pump and Off-Pump Coronary Artery Bypass Grafting

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ABSTRACT

Background: Coronary artery bypass grafting (CABG) remains one of the finest surgical techniques for treating severe coronary artery disease. Traditional on pump CABG is still widely in use but off-pump CABG has gained popularity as a substitute method to reduce the side effects of cardiopulmonary bypass. The superiority of either strategy in terms of clinical results and postoperative complications, however, is still up for debate.

Aim of the Study: To assess the prevalence and predictors of early postoperative complications in patients receiving on-pump versus off-pump CABG.

Patients and Methods: This prospective observational cohort study was conducted at the Cardiothoracic Surgery Department, National Heart Institute, Cairo, Egypt, and Shebein Elkom Teaching Hospital, Shebein Elkom, Menoufia, Egypt on 120 patients receiving isolated CABG who were divided equally into two groups: the off-pump CABG group and the on-pump CABG group.

Results: On-pump CABG was related with prolonged operating time, mechanical ventilation, ICU and hospital stay. The unadjusted rate of patients with at least 1 postoperative complication was greater in the on-pump group. There were no statistically significant between-group differences in postoperative atrial fibrillation, myocardial infarction, stroke or transient ischaemic attack, acute renal injury, bleeding necessitating re-exploration, or 30-day mortality.

Conclusion: Off-pump CABG was associated with shorter mechanical ventilation duration, ICU stay, and hospital stay and with a lower unadjusted incidence of the composite outcome of any early postoperative complication. However, the two techniques showed no statistically significant differences in individual major complications or 30-day mortality.

KEYWORDS: Coronary artery bypass grafting; On-pump CABG; Off-pump CABG; Cardiopulmonary bypass; Post-operative problems.

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INTRODUCTION

Coronary heart disease (CHD) continues to be the leading cause of death worldwide. CABG, or coronary artery bypass grafting, currently the most common cardiac surgery technique carried out globally, is used to treat CHD [1].

During coronary artery bypass graft (CABG) Surgically, occluded coronary arteries are bypassed and blood flow to the ischaemic myocardium is re-established by using a conduit of an artery or vein harvested from another location of the body. Current guidelines favour coronary artery bypass grafting (CABG) over percutaneous coronary intervention (PCI) in diabetic patients with multi-vessel disease involving the left anterior descending artery to reduce mortality and repeat revascularizations. CABG reduces the death rate considerably at five, seven, and ten years among patients with stable coronary artery disease as compared with medical therapy alone [2].

Many symptoms are more common in patients receiving CABG. The most prevalent symptom before to CABG has been observed to be angina pectoris or chest pain. Early complications after CABG may include myocardial infarction, arrhythmias, low output syndrome, stroke, acute renal damage, respiratory difficulties, haemorrhage, surgical-site infection, and death. For these individuals, preventing these consequences is crucial [3].

Dyspnoea, anxiety, sadness, low appetite, leg oedema, arrhythmia, sleep problems, soreness from an incision, weariness, and angina are just a few of the symptoms have been reported in individuals receiving CABG in earlier research. Patients' everyday activities, sleep, and general well-being are all hampered by these symptoms. Delays in wound healing and an increased risk of death occur if these symptoms continue [4,5].

Advanced age, diabetes mellitus, renal dysfunction, impaired left ventricular function, cerebrovascular disease, and extensive coronary artery disease are recognized risk factors for adverse outcomes after CABG [6].

The study's goal was to determine the frequency, types, potential causes, and risk factors of complications after CABG.

PATIENTS AND METHODS

This was a prospective observational cohort study conducted at the Cardiothoracic Surgery Department, National Heart Institute, Cairo, Egypt, and Shebein Elkom Teaching Hospital, Shebein Elkom, Menoufia, Egypt. A total of 120 patients who had undergone CABG surgery during the study period were included.

Inclusion criteria Patients aged ≥18 years undergoing primary isolated coronary artery bypass graft (CABG) surgery after diagnosis of coronary artery disease (CAD) and recommendation of surgical revascularisation were eligible to participate in the study after giving their informed consent. Patients were excluded if they underwent combined cardiac procedures (such as CABG with valve replacement), had a history of previous CABG surgery, were diagnosed with congenital heart disease, had severe hepatic or renal failure, presented with active infection or sepsis preoperatively, or had incomplete clinical data or declined to participate in the study.

Preoperative Assessment: A thorough preoperative evaluation comprising in-depth clinical, laboratory, and imaging evaluations was performed on every patient. A comprehensive general and cardiovascular examination was performed after a thorough history was taken, with a focus on demographic information (age and sex), smoking status, related comorbidities like diabetes mellitus, hypertension, and dyslipidemia, as well as any prior history of myocardial infarction. Complete blood count (CBC), liver function tests, renal function tests (serum creatinine and urea), coagulation profile (prothrombin time and international normalized ratio), lipid profile, and glycemic status evaluation using random blood glucose and glycated hemoglobin (HbA1c) were among the laboratory investigations. Resting electrocardiography (ECG), transthoracic echocardiography to assess left ventricular ejection fraction (LVEF) The imaging and diagnostic workup included coronary angiography to determine the number of diseased arteries as well as the degree and anatomical location of coronary artery stenosis, as well as to detect anomalies in regional wall motion.
Operative Data: All patients who had CABG had their occluded coronary arteries bypassed utilising internal thoracic artery (ITA) grafts. The quantity of diseased arteries, along with their size and anatomical distribution, determined the number of grafts (shunts). Based on the surgical approach, patients were split into two groups: on-pump CABG and off-pump CABG. Cardiopulmonary bypass (CPB) surgery with aortic cross-clamping and cardioplegic arrest was performed on the on-pump group, and cold cardioplegia was used to protect the heart. Using stabilizing devices to enable accurate coronary anastomosis, the off-pump group underwent surgery on a beating heart without the assistance of CPB. Every patient's intraoperative data, such as the number of grafts performed, the type of grafts used (arterial with or without venous grafts), the overall length of the procedure, the CPB time for patients operated on-pump, the aortic cross-clamp time, and any intraoperative complications encountered, were meticulously documented.

Postoperative Follow-Up:
All patients were followed during immediate postoperative period (ICU stay), hospital stay and short-term follow-up (up to 30 days post-surgery).

Outcome Measures:
The composite outcome (any early postoperative complication) was defined as the incidence of any of the following during hospitalisation or within 30 days of surgery: postoperative atrial fibrillation, myocardial infarction , poor cardiac output syndrome , atelectasis, pneumonia, prolonged mechanical ventilation, stroke, transient ischemic attack, acute kidney injury, sternal wound infection, sepsis, bleeding requiring re-exploration, deep vein thrombosis, or death. Each patient was counted only once in the composite outcome, regardless of the number of complications experienced.

Definitions of postoperative outcomes
Postoperative myocardial infarction was defined according to the Fourth Universal Definition of Myocardial Infarction . KDIGO criteria were used to define acute renal damage. Low cardiac output syndrome was characterised as the requirement for prolonged inotropic or mechanical circulatory support to maintain adequate systemic perfusion. Atelectasis was defined as postoperative radiographic evidence of pulmonary collapse or loss of lung capacity needing active therapy. Stroke was defined as a new focal or global neurological deficit lasting >24 hours, while transient ischaemic attack was defined as a transitory neurological deficit without permanent harm. Bleeding requiring re-exploration was defined as postoperative bleeding necessitating return to the operating room. Sternal wound infection was diagnosed on the basis of clinical evidence of superficial or deep sternal wound infection.

Risk Factor Assessment: Patient-related, operational, and postoperative data were used to systematically evaluate potential risk factors for problems following coronary artery bypass (CABG). Patient associated characteristics included age, sex, smoking status, body mass index (BMI) a measure of obesity and presence of comorbid diseases such as diabetes mellitus, hypertension, dyslipidaemia and left ventricular dysfunction as assessed by preoperative echocardiography. operating variables such as number of grafts performed, surgical technique (off-pump versus on-pump with cardiopulmonary bypass), total operating time, and aortic cross-clamp time in patients undergoing on-pump surgery were evaluated. Two postoperative features, the duration in the intensive care unit (ICU) and the duration of mechanical breathing, were evaluated as possible causes of postoperative difficulties.

STATISTICAL ANALYSIS

The collected data were entered into a computer and statistically analysed using SPSS (Statistical Package for Social Science) software version 27.0 (IBM, 2020). Qualitative data were provided in relative percentages and frequencies. The qualitative variables were compared using the Chi-square test. When one or more of the cells analysed had less than five, qualitative characteristics in distinct groups were compared by Fisher's exact test. Quantitative data are presented as mean ± SD (standard deviation). The independent T test was used to determine the difference between quantitative variables in two sets of normally distributed data. Mann Whitney (MW) test was used to evaluate quantitative variables between two groups with data that was not normally distributed. We did univariate and multivariable logistic regression analysis to determine characteristics related with early postoperative complications. The model includes surgical method, age, prior myocardial infarction, LVEF, left main disease and number of diseased arteries. Crude and adjusted odds ratios with 95% confidence intervals were presented. Statistical significance was defined as a P-value < .05.

RESULTS

Table 1. Comparison of demographic and baseline clinical characteristics between on-pump and off-pump CABG groups

Variable	On-pump CABG (n=60)	Off-pump CABG (n=60)	P-value
Age (years)	60.2 ± 7.35	59.1 ± 7.2	0.41
Range	48–76	47–75	
Sex			1.000
Male	51 (85.0%)	50 (83.3%)	
Female	9 (15.0%)	10 (16.7%)	
Smoking status			0.086
Never	30 (50.0%)	31 (51.7%)	
Former	20 (33.3%)	11 (18.3%)	
Current	10 (16.7%)	18 (30.0%)	
BMI (kg/m²)	29.10 ± 3.25	28.70 ± 2.96	0.484
Range	22.9–36.1	22.0–35.9	
BMI category			0.617
Normal	8 (13.3%)	5 (8.3%)	
Overweight	30 (50.0%)	34 (56.7%)	
Obese	22 (36.7%)	21 (35.0%)	
Obesity	22 (36.7%)	21 (35.0%)	1.000
Diabetes mellitus	39 (65.0%)	35 (58.3%)	0.573
Hypertension	46 (76.7%)	43 (71.7%)	0.677
Dyslipidemia	43 (71.7%)	36 (60.0%)	0.248
Prior MI	18 (30.0%)	16 (26.7%)	0.68
History of stroke/TIA	10 (16.7%)	5 (8.3%)	0.270
Carotid artery stenosis	6 (10.0%)	4 (6.7%)	0.741
Preoperative renal dysfunction	6 (10.0%)	6 (10.0%)	1.000

CABG: coronary artery bypass grafting, BMI: body mass index, MI: myocardial infarction, TIA: transient ischemic attack.
There were no discernible statistically significant differences between the two groups concerning age, sex distribution, smoking status, BMI, BMI categories, obesity, or major comorbidities previous myocardial infarction, history of stroke or transient ischemic attack, carotid artery stenosis, and preoperative renal dysfunction (p > 0.05 for all) **(Table 1).**

Table 2. Comparison of preoperative laboratory parameters between on-pump and off-pump CABG groups

Variable	On-pump CABG (n=60)	Off-pump CABG (n=60)	P-value
Serum creatinine (mg/dL)	1.12 ± 0.23	1.09 ± 0.22	0.488
Range	0.71–1.89	0.70–1.64	
Urea (mg/dL)	37.12 ± 8.75	35.58 ± 9.03	0.347
Range	22–60	18–61	
Hemoglobin (g/dL)	13.33 ± 1.11	13.03 ± 1.00	0.131
Range	11.0–15.8	10.3–14.9	
Platelets (×10³/µL)	251.45 ± 45.22	242.28 ± 44.35	0.265
Range	151–390	156–341	
INR	1.08 ± 0.08	1.08 ± 0.07	0.972
Range	0.93–1.28	0.90–1.26	
Random blood glucose (mg/dL)	138.43 ± 35.97	143.77 ± 33.45	0.402
Range	85–233	85–248	
HbA1c (%)	6.86 ± 1.09	6.61 ± 1.13	0.212
Range	5.0–8.7	4.8–9.2	

CABG: coronary artery bypass grafting, INR: international normalized ratio, HbA1c: glycated hemoglobin.
Serum creatinine, urea, haemoglobin level, platelet count, INR, random blood glucose and HbA1c levels showed no statistically significant variations between on-pump and off-pump CABG groups (p > 0.05 for all) **(Table 2).**

Table 3. Comparison of preoperative cardiac and angiographic findings between on-pump and off-pump CABG groups

Variable	On-pump CABG (n=60)	Off-pump CABG (n=60)	P-value
LVEF (%)	50.8 ± 6.4	51.6 ± 6.2	0.49
Range	35–65	36–65	
LVEF category			0.91
Normal	16 (26.7%)	18 (30%)	
Mild dysfunction	34 (56.7%)	32 (53.3%)	
Moderate-severe dysfunction	10 (16.7%)	10 (16.7%)	
RWMA	26 (43.3%)	22 (36.7%)	0.576
Number of diseased vessels			0.57
2-vessel disease	21 (35%)	24 (40%)	
3-vessel disease	39 (65%)	36 (60%)	
Left main disease	10 (16.7%)	8 (13.3%)	0.60
Maximum coronary stenosis (%)	89.8 ± 5.9	89.1 ± 5.8	0.52
Range	75–100	75–100	

CABG: coronary artery bypass grafting, LVEF: left ventricular ejection fraction, RWMA: regional wall motion abnormality.
There was no significant difference betweeb both groups regarding preoperative cardiac and angiographic findings (p > 0.05). **(Table 3).**

Table 4. Comparison of operative characteristics between on-pump and off-pump CABG groups

Variable	On-pump CABG (n=60)	Off-pump CABG (n=60)	P-value
Number of grafts	3.13 ± 0.62	2.93 ± 0.78	0.123
Range	2–4	2–4	
Graft type			0.454
Arterial only	21 (35.0%)	26 (43.3%)	
Arterial + venous	39 (65.0%)	34 (56.7%)	
Surgery duration (min)	224.63 ± 28.44	188.35 ± 23.30	**<0.001**
Range	153–283	140–246	
CPB used	60 (100.0%)	0 (0.0%)	**<0.001**
CPB time (min)	96.67 ± 16.30	—	—
Range	64–134	—	
Cross-clamp time (min)	59.63 ± 14.12	—	—
Range	28–89	—	
Intraoperative complication	3 (5.0%)	7 (11.7%)	0.322

CABG: coronary artery bypass grafting, CPB: cardiopulmonary bypass.
The quantity or kind of grafts performed did not change statistically significantly between the two groups (p > 0.05). But compared to the off-pump group, the on-pump CABG group's surgical time was noticeably longer (p < 0.001). Cardiopulmonary bypass (CPB) was only utilized in the on-pump group, as was to be predicted, and the two groups differed significantly (p < 0.001). Only the on-pump group's mean CPB and aortic cross-clamp times were noted. Regarding intraoperative complications, there was no statistically significant difference between the two groups. (p > 0.05) **(Table 4).**

Table 5. Comparison of early postoperative outcomes between on-pump and off-pump CABG groups

Variable	On-pump CABG (n=60)	Off-pump CABG (n=60)	P-value
Mechanical ventilation (hours)	18.07 ± 6.89	11.40 ± 4.84	**<0.001**
Range	6.8–35.2	4.0–25.5	
Prolonged MV >24 h	13 (21.7%)	1 (1.7%)	**0.002**
ICU stay (days)	3.48 ± 0.99	2.56 ± 0.91	**<0.001**
Range	1.3–5.7	1.0–5.6	
Hospital stay (days)	8.60 ± 1.58	6.80 ± 1.24	**<0.001**
Range	5.6–12.1	5.0–9.8	

CABG: coronary artery bypass grafting, MV: mechanical ventilation, ICU: intensive care unit.

The on-pump CABG group's mechanical ventilation time was substantially longer than the off-pump group's (p < 0.001). Furthermore, the on-pump group had a significantly greater incidence of extended mechanical breathing (>24 hours) (p = 0.002). Additionally, the on-pump CABG group's ICU stay and overall hospital stay were considerably longer than those of the off-pump group (p < 0.001 for both), suggesting a more complex early postoperative course in this group. **(Table 5).**

Table 6. Comparison of postoperative complications between on-pump and off-pump CABG groups

Variable	On-pump CABG (n=60)	Off-pump CABG (n=60)	P-value
Atrial fibrillation	14 (23.3%)	9 (15.0%)	0.354
Postoperative MI	3 (5.0%)	2 (3.3%)	1.000
Low cardiac output	7 (11.7%)	2 (3.3%)	0.163
Atelectasis	11 (18.3%)	6 (10.0%)	0.295
Pneumonia	9 (15.0%)	3 (5.0%)	0.128
Stroke	2 (3.3%)	1 (1.7%)	1.000
TIA	4 (6.7%)	1 (1.7%)	0.364
AKI (KDIGO)	5 (8.3%)	4 (6.7%)	1.000
Sternal wound infection	2 (3.3%)	0 (0.0%)	0.496
Sepsis	1 (1.7%)	0 (0.0%)	1.000
Bleeding requiring re-exploration	1 (1.7%)	1 (1.7%)	1.000
DVT	0 (0.0%)	0 (0.0%)	—
30-day mortality	1 (1.7%)	1 (1.7%)	1.000
Patients with ≥1 early postoperative complication	39 (65.0%)	24 (40.0%)	**0.010**

CABG: coronary artery bypass grafting, MI: myocardial infarction, AKI: acute kidney injury, TIA: transient ischemic attack, DVT: deep vein thrombosis.

Individual complications such as atrial fibrillation, postoperative myocardial infarction, low cardiac output, atelectasis, pneumonia, stroke, transient ischemic attack, acute kidney injury, sternal wound infection, sepsis, bleeding requiring re-exploration, deep vein thrombosis, and 30-day mortality did not differ statistically significantly between the on-pump and off-pump CABG groups (p > 0.05 for all). On the other hand, the on-pump CABG group had a significantly greater overall incidence of postoperative problems than the off-pump group (p = 0.010). **(Table 6).**

Table 7. Univariable and multivariable logistic regression analysis of factors associated with early postoperative complications

Variable	Crude OR	95% CI	P-value	Adjusted OR	95% CI	P-value
On-pump CABG vs. off-pump CABG	**2.79**	**1.33–5.84**	**0.007**	2.27	0.94–5.48	0.069
Age, per one-year increase	1.03	0.98–1.08	0.223	1.01	0.96–1.07	0.643
Previous myocardial infarction	1.35	0.63–2.91	0.439	1.06	0.45–2.47	0.895
LVEF, per 1% increase	0.98	0.93–1.03	0.437	1.00	0.94–1.06	0.937
Left main coronary artery disease	2.66	0.95–7.41	0.062	1.95	0.66–5.82	0.230
Number of diseased coronary vessels, per additional vessel	1.57	0.73–3.37	0.246	1.16	0.50–2.71	0.726

CABG, coronary artery bypass grafting; CI, confidence interval; LVEF, left ventricular ejection fraction; OR, odds ratio.

On univariable logistic regression analysis, on-pump CABG was significantly associated with higher odds of developing at least one early postoperative complication compared with off-pump CABG (crude OR=2.79, 95% CI: 1.33–5.84, P=0.007). However, after adjustment for age, previous myocardial infarction, LVEF, left main coronary artery disease, and the number of diseased coronary vessels, the association was attenuated and was no longer statistically significant (adjusted OR=2.27, 95% CI: 0.94–5.48, P=0.069). None of the other included clinical or angiographic variables was independently associated with the occurrence of early postoperative complications.

DISCUSSION

In the current study, age, the distribution of sexes, smoking status, BMI, obesity, diabetes mellitus, hypertension, dyslipidemia, cerebrovascular disease, and preoperative renal impairment did not differ statistically significantly between the two groups.

These results are somewhat in line with those of **Diegeler et al. [7],** who conducted a multicenter randomised controlled trial in 2539 patients aged ≥75 years receiving CABG. To compare off-pump vs on-pump CABG outcomes in the elderly, the researchers discovered that the two groups' baseline demographics were similar and that there were no significant variations in cardiovascular risk factors or comorbidities.

Similarly, **Shroyer et al. [8]**, revealed no discernible baseline differences between the off-pump and on-pump groups' cardiovascular risk profiles or concomitant conditions in a sizable randomized controlled trial with 2203 participants. The study concluded that randomization reduced demographic differences across groups and sought to evaluate both short- and long-term results following both surgical methods.

In the present investigation, there was no significant difference between both groups with respect to the pre-operative cardiac and angiographic data (p > 0.05).

Rustenbach et al. [9] comprised patients after CABG at four university hospitals who had cardiac failure and a decreased ejection fraction. In patients with impaired ventricular function, they intended to compare the perioperative effects of off-pump versus on-pump CABG. Researchers discovered that individuals selected for on-pump CABG frequently had more advanced coronary disease and reduced ventricular function, which is consistent with surgeons' preference for full revascularization in more complex coronary anatomy.

Sheikhy et al., [10] found that individuals undergoing on-pump CABG frequently had more extensive coronary lesions and a complicated anatomical disease load, according to a registry-based propensity score–matched study encompassing 8163 patients treated between 2014 and 2016. Coronary complexity and ventricular performance had a significant impact on surgical choice, according to the study, which compared perioperative outcomes after balancing baseline variables**.**

The quantity of grafts and type of grafts did not significantly differ between the two groups in this study. On the other hand, the on-pump CABG group's operating time was noticeably longer.

These findings are consistent with **Shroyer et al. [8]**, who, as a result of cardiopulmonary bypass setup, cannulation, and aortic cross-clamping operations, showed noticeably higher surgical complexity and increased procedural duration in on-pump CABG. Off-pump surgery may lessen surgical invasiveness and procedure time, according to the experiment, which assessed perioperative outcomes and graft patency.

In a similar vein, **Sheikhy et al. [10]** found that the off-pump group recovered more quickly both during and after surgery.

In order to determine whether technique may be safer in terms of cardiac function, **Asklany et al. [11]** was to evaluate our experience with off-pump or on-pump coronary artery bypass surgery in patients with EF (25% to 40%). They stated that there were almost identical numbers of grafts concurrently. Regarding the sequential or independent vein grafts, there were no technical differences.

According to the current study, patients receiving on-pump CABG had considerably longer mechanical ventilation durations, a greater incidence of prolonged ventilation (>24 hours), longer ICU stays, and longer hospital stays.

These results are highly congruent with those of **Rustenbach et al. [9],** who found that OPCAB patients had much shorter ICU stays and durations of mechanical ventilation. The off-pump group had decreased incidence of sepsis and delirium, among other postoperative morbidities, according to the study.

Additionally, **Sheikhy et al., [10]** reported significantly shorter intubation time, ICU stay, and total hospitalization among off-pump CABG patients. One possible explanation is the avoidance of cardiopulmonary bypass, which has been associated in previous studies with systemic inflammatory and physiological responses. However, inflammatory biomarkers were not measured in the present study; therefore, this mechanism remains hypothetical and cannot be confirmed by our findings.

In a retrospective cohort research with 1569 patients, **Ibrahim and Joyo [12]** discovered that although there was no difference in mortality between the groups, off-pump CABG patients had significantly longer ICU stays. A difference in the length of stay in the intensive care unit was found by the study, which aimed to compare postoperative outcomes between patients with OPCAB and those with ONCAB.

According to **Diegeler et al. [7],** We found no statistically significant differences between on-pump and off-pump CABG with respect to duration of mechanical ventilation, ICU stay or total hospital stay.

Variations in patient selection criteria, surgeon experience, perioperative ICU discharge procedures, and institutional postoperative care protocols may account for this disparity. Furthermore, independent of surgical method, retrospective design and variation in postoperative care may have affected the length of ICU stay.

In relation to specific post-operative complications such as atrial fibrillation, myocardial infarction, low cardiac output syndrome, pulmonary complications, the present study did not show any statistically significant difference between the two groups regarding cerebrovascular events, acute kidney injury (AKI), wound infection, bleeding requiring re-exploration and 30-day mortality. On the other hand, the total postoperative complication rate was significantly greater in the on-pump CABG group. Although the composite incidence of any postoperative complication was higher in the on-pump group, none of the individual major complications, including postoperative myocardial infarction, stroke, acute kidney injury, bleeding requiring re-exploration, or 30-day mortality, differed significantly between the groups. The composite finding should therefore be interpreted cautiously, particularly because it may have been driven by more frequent but less severe postoperative events and because the study was not randomized.

These results are mostly in line with those of **Shroyer et al. [8],** They found no significant difference in severe adverse cardiac events or short term mortality in off-pump and on-pump CABG groups. At age one, the experiment found that off-pump patients had somewhat lower long-term composite results.

According to **Head et al., [13]** the off-pump approach was better than ONCABG regarding mortality. A further study by **Khan et al. [14]** notes that the ONCABG approach raises the risk of death because it increases the incidence of SIRS, which can lead to septic shock-related death. But, **Gaudino et al. [15]** Contrary to what they reported, they found that compared to ONCABG, OPCABG is associated with an increased rate of incomplete revascularisation, an increased need for re-revascularization, and decreased midterm survival.

Accordingly, **Tariq et al. [16]** found that there was no benefit to OPCAB over C-CABG in terms of surgical AF incidence. OPCAB had substantially reduced stroke rates than C-CABG, according to **Patel et al. [17].**

The current study has a number of limitations that should be noted. First, the capacity to identify statistically significant variations in less common complications and mortality outcomes may have been hampered by the very small sample size. Second, the observational, non-randomized, two-center design was susceptible to selection bias and confounding by indication. Third, long-term results including quality of life, Graft patency, recurrent revascularization, and long-term survival were not evaluated. Future multicenter randomized studies with bigger sample numbers and longer follow-up periods should further clarify the comparative long-term results of on-pump versus off-pump CABG, particularly in high-risk populations including elderly patients and those with significant ventricular dysfunction. Inflammatory biomarkers were not measured; therefore, the study could not directly evaluate whether differences in systemic inflammatory activation contributed to the observed postoperative outcomes.

CONCLUSION

In this observational cohort, off-pump CABG was associated with shorter mechanical ventilation duration, ICU stay, and hospital stay, as well as a lower unadjusted incidence of the composite outcome of any early postoperative complication. However, there were no statistically significant differences between the two procedures in terms of individual major postoperative complications or 30-day mortality. Larger risk-adjusted and randomised investigations are required to evaluate if the observed differences are independently associated with surgical technique.

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