

CASE REPORT

Off-Pump Coronary Artery Bypass with Incomplete Revascularization in a Patient with Severely Reduced LVEF: A Case Report and Literature Review

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Abstract

Background: Patients with ischemic cardiomyopathy and severely reduced left ventricular ejection fraction (LVEF $\leq 30\%$) face high operative risk during CABG, particularly when cardiopulmonary bypass (CPB) is used. Off-pump CABG may reduce complications in these patients, though incomplete revascularization is sometimes necessary due to anatomical or clinical constraints.

Case Summary: A 67-year-old male with ischemic cardiomyopathy (LVEF 20%), multivessel coronary artery disease, renal dysfunction, and significant dilatation of the left heart chambers underwent incomplete revascularization via OPCAB. A left internal mammary artery graft was placed to the anterior intraventricular coronary artery, the most viable and surgically accessible vessel. PCI was not pursued due to diffuse calcification and poor distal targets. The patient remained stable postoperatively and showed improvement in LVEF to 30% and NYHA Class II symptoms at two-year follow-up.

Outcome: The patient remained clinically stable without readmissions or recurrent ischemic events and continues guideline-directed therapy with satisfactory quality of life.

Conclusion: In select high-risk patients with poor coronary anatomy and severely reduced LVEF, incomplete revascularization via OPCAB guided by myocardial viability may provide durable functional and echocardiographic improvement. Further studies are needed to guide patient selection and long-term outcomes.

Keywords: OPCAB, Incomplete revascularization, Low ejection fraction, Ischemic cardiomyopathy, Multivessel coronary artery disease, Myocardial viability, High-risk cardiac surgery.

Introduction

Patients with ischemic cardiomyopathy and severely reduced left ventricular ejection fraction (LVEF $\leq 30\%$) are at risk for high perioperative complications during coronary artery bypass grafting (CABG), particularly when cardiopulmonary bypass (CPB) is employed. CPB can exacerbate myocardial depression, worsen renal function, and increase perioperative morbidity in this vulnerable group [1,2]. Off-pump CABG (OPCAB), which avoids CPB, has been proposed as a safer alternative for high-risk patients, showing comparable long-term outcomes and fewer complications [3–5]. Although clinical guidelines favor complete revascularization in ischemic cardiomyopathy [8,9], anatomical and clinical constraints often limit grafting

options. In such cases, an individualized, targeted or incomplete revascularization, focusing on the most viable and accessible coronary territories, may offer functional improvement while balancing procedural safety and long-term outcomes [10–12].

We present a case of successful OPCAB with incomplete revascularization in a patient with severely reduced LVEF, highlighting how functional, targeted intervention can yield durable outcomes in complex surgical scenarios.

Case Presentation

A 67-year-old male patient with a history of ischemic cardiomyopathy and severely reduced left ventricular ejection fraction (LVEF 20%) was referred to our cardiac

surgery department for surgical revascularization. He presented with New York Heart Association (NYHA) Class III symptoms, including exertional dyspnea and reduced exercise tolerance. Preoperative coronary angiography revealed multivessel coronary artery disease involving the left anterior descending (LAD), diagonal branch, and right coronary arteries, with a dominant left system. Transthoracic echocardiography showed a severely dilated left ventricle and left atrium, consistent with chronic volume overload and longstanding systolic dysfunction. The marked dilation of the left-sided chambers added to the surgical complexity by altering normal cardiac geometry and reducing hemodynamic reserve.

The patient's medical history was notable for chronic heart failure with reduced ejection fraction, moderate chronic kidney disease with elevated baseline serum creatinine (2.1 mg/dL), poorly controlled hypertension, and anemia of chronic disease. The LAD was heavily calcified with poor distal target quality, and the RCA was excluded due to its diffusely diseased nature. Percutaneous coronary intervention (PCI) was not pursued due to diffuse calcification, poor distal targets, and limited anticipated benefit in the setting of severely reduced ventricular function. Given the high operative risk (EuroSCORE II: 7.9%) and the anticipated hemodynamic instability from cardiopulmonary bypass, the multidisciplinary heart team opted for a strategy of incomplete revascularization via off-pump coronary artery bypass (OPCAB) surgery. A left internal mammary artery (LIMA) graft was anastomosed to the anterior intraventricular coronary artery (RIVA), which was the most viable and surgically accessible target vessel.

The off-pump procedure was completed without intraoperative complications. The patient was extubated six hours postoperatively and required minimal inotropic support (low-dose dopamine, discontinued within 24 hours). He remained hemodynamically stable throughout the intensive care unit course and was discharged home on postoperative day 7. Echocardiography prior to discharge showed no further decline in LVEF.

At the two-year follow-up, echocardiography confirmed an improvement in LVEF to 30%, and the size of the left-sided cardiac chambers remained stable without further dilation and has improved symptomatically to NYHA Class II. He has not required any hospital readmissions for heart failure or ischemic events and continues to be managed with guideline-directed medical therapy. No further coronary interventions have been necessary, and the patient reports satisfactory quality of life despite the incomplete revascularization strategy.

Discussion

Cardiopulmonary bypass (CPB) plays a significant role in increasing surgical risk for patients with severely reduced

left ventricular ejection fraction (LVEF <30%). Recent meta-analyses and propensity-matched cohort studies have shown that off-pump coronary artery bypass grafting (OPCAB), which avoids the use of CPB, is associated with improved long-term outcomes in high-risk patients. Specifically, OPCAB has been linked to lower rates of perioperative mortality, stroke, renal failure, and bleeding, as well as shorter ICU and hospital stays [1–3]. Although off-pump surgery may sometimes result in less complete revascularization, its intraoperative stability makes it an appealing option for patients with poor ventricular function [4].

Complete revascularization remains the preferred strategy for patients with ischemic cardiomyopathy undergoing coronary artery bypass grafting. The 2024 ESC guidelines and the 2023 AHA/ACC guidelines for chronic coronary syndromes recommend complete revascularization in patients with multivessel coronary artery disease and LVEF $\leq 35\%$, citing improved survival, reduced myocardial infarction risk, and delayed progression of heart failure [8,9]. However, both guidelines recognize that complete revascularization is not always technically feasible due to poor distal vessel quality, diffuse disease, or increased surgical risk. In such cases, individualized surgical planning focused on revascularizing the most functionally significant or viable myocardium is considered a reasonable and evidence-based approach [8,9].

While complete revascularization is the ideal, recent evidence suggests that incomplete revascularization may still offer significant benefit in patients with ischemic cardiomyopathy when anatomical or clinical limitations exist. The STICH and STICHES trials demonstrated that surgical revascularization significantly improves survival in patients with low EF compared to medical therapy [6,7]. Importantly, studies have shown that viability-guided and functionally targeted revascularization, even when anatomically incomplete, can achieve favorable outcomes [10]. LIMA-to-LAD-only grafting has shown high patency rates and symptom relief, particularly in high-risk patients with limited graftable targets [11]. These data support a paradigm shift toward pragmatic, benefit-oriented surgical strategies that consider risk-benefit balance over anatomical completeness [12].

In the presented case, multiple high-risk features — including severely reduced EF, renal dysfunction, diffuse coronary artery disease, and marked dilation of the left-sided cardiac chambers, as evidenced by elevated left ventricular end-diastolic volume (LVEDV) — contributed to the decision to avoid CPB and pursue limited revascularization. The patient's left anterior descending artery (LAD), referred to locally as the ramus interventricularis anterior (RIVA), was heavily calcified distally, limiting grafting feasibility. Although formal viability imaging (such as PET or dobutamine stress

echocardiography) was not performed, transthoracic echocardiography revealed preserved contractile reserve in the anterior wall, supporting the decision to revascularize the LAD territory. The choice of LIMA-to-LAD (RIVA) grafting was made based on vessel accessibility, viability, and surgical safety. Notably, at the two-year follow-up, the patient showed both clinical and echocardiographic improvement, with LVEF increasing from 20% to 30% and LVEDV remaining stable without further chamber dilation.

This case highlights how functional, patient-tailored revascularization can yield durable outcomes, especially when performed in a stable off-pump setting in select patients with ischemic cardiomyopathy. Although current guidelines do not provide explicit recommendations for incomplete revascularization, several studies provide emerging evidence that even partial revascularization can have meaningful clinical effects [11,12]. Similar outcomes were reported by Ji et al. [13], where incomplete off-pump revascularization in high-risk patients resulted in preserved left ventricular function and improved clinical status at one-year follow-up. Moreover, this case adds to the limited pool of real-world evidence suggesting that targeted myocardial revascularization, guided by feasibility and viability rather than anatomical perfection, may be a safe and effective alternative in high-risk surgical candidates.

However, further prospective studies are needed to better define patient selection criteria, optimal graft targets, and long-term outcomes associated with incomplete revascularization in patients with severely reduced EF.

Conclusion

This case demonstrates that incomplete, viability-guided off-pump coronary artery bypass grafting (OPCAB) can be a safe and effective surgical strategy in selected high-risk patients with severely reduced left ventricular ejection fraction (LVEF). Despite the inability to achieve complete anatomical revascularization due to diffuse coronary artery disease and calcification, targeted grafting of the most viable territory resulted in meaningful long-term clinical and echocardiographic improvement. The patient's stable recovery, absence of recurrent ischemic events, and improved LVEF over a two-year follow-up highlight the potential benefits of individualized revascularization strategies. In patients with limited graftable anatomy and elevated operative risk, a targeted OPCAB approach based

on myocardial viability offers a reasonable alternative to complete revascularization. Future studies are warranted to clarify patient selection criteria, identify outcome predictors, and further standardize this surgical strategy.

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