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Case Report

An Elegant Approach for Complete Revascularization of the Circumflex Territory

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Abstract

Revascularization of the circumflex artery territory is challenging due to its anatomical position and technical complexity. We present a novel approach using the proximal circumflex trunk for arterial bypass, ensuring natural antegrade blood flow and avoiding multiple distal anastomoses. This streamlined technique minimizes grafting complications and achieves efficient revascularization in complex left main disease.

Keywords: circumflex; revascularization; left main; CABG; new technique

1. Introduction

In left main coronary artery stenosis, it is not uncommon for the LAD and the circumflex territories to remain free from additional lesions. Revascularization typically involves arterial bypasses to both territories. While the left internal thoracic artery (LITA) is often easily grafted to the proximal LAD, revascularizing the circumflex territory presents greater challenges. The flow through these anastomoses on small arteries is much reduced compared to what could be obtained if the anastomosis was performed on the trunk of the vessel. In a previous article, we described the advantages of a surgical angioplasty of the left main coronary artery over the creation of multiple distal anastomoses [1]. This elegant approach is suitable for proximal stenosis of the trunk. When its distal part is involved a more conventional revascularization is recommended. Building on this same philosophy, we propose the innovative use of the circumflex artery trunk as a direct target to achieve complete and efficient revascularization of this territory.

2. Case Presentation

A 76-year-old male patient was referred for surgical treatment of an ascending aortic aneurysm. His medical history included prior stenting of the proximal LAD. Preoperative imaging revealed significant stenosis of the distal left main trunk and at the stent site, while the circumflex artery demonstrated a short trunk before the origin of the first marginal branch and remained free of additional stenosis (Figure 1).

Both internal thoracic arteries were harvested. Cardiopulmonary bypass (CPB) was initiated, and cold blood cardioplegia was administered. The aneurysmal ascending aorta was replaced with a Dacron graft. Coronary revascularization was then initiated (Video 1). To access the circumflex artery, the heart was gently elevated using a pad placed under the left ventricle, and the pulmonary trunk was retracted medially with a stay suture. The proximal LAD and the emergence of the left atrial appendage served as key anatomical landmarks. Using low-voltage electrocautery, the overlying fat tissue was carefully incised. Subtle, current-free movements with the cautery blade allowed for the tactile identification of the circumflex artery, distinguished by its unique wall consistency. After confirmation, the artery was meticulously dissected and encircled with a vascular loop, a step facilitated by its superficial location not embedded in the myocardium in this segment. This approach provided optimal visualization and ease of handling of the artery for subsequent anastomosis.

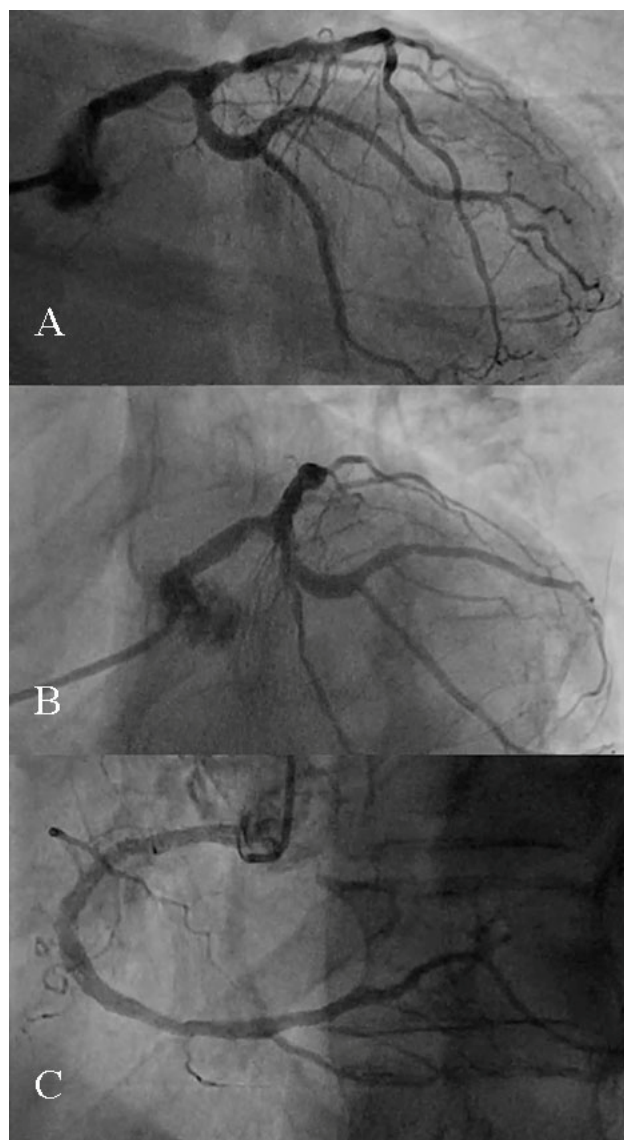


Figure 1. Coro-angiography displaying a stenosis on the distal left main and another one on the proximal LAD. The circumflex artery shows a trunk and two marginal arteries free of any stenosis(A,B). The right coronary artery shows no relevant stenosis(C).

The pedicled right thoracic artery (RITA) was tunneled through the pericardium, passing above the superior vena cava, carefully avoiding the phrenic nerve, and through the transverse sinus to reach the circumflex trunk. An incision was made in the circumflex artery, and the distal end of the RITA was shortened and beveled to achieve an exact fit. An end-to-side anastomosis was then completed using a running suture with a prolene 8/0 (J&J MedTech, New Jersey, USA). The left internal thoracic artery (LITA) was subsequently anastomosed to the proximal LAD (Figure 2).

Following meticulous de-airing of the heart and graft, all clamps were released, and the heart resumed excellent function. CPB was smoothly weaned, and intraoperative graft verification using transit-time flow measurement yielded excellent results. The right internal thoracic graft demonstrated a mean flow of 55 mL/min with a pulsatility index of 1.5, indicating optimal graft performance. The patient's postoperative recovery was uneventful, and at the 1-year follow-up, he remained in excellent clinical condition, with no complications or evidence of graft dysfunction, confirmed by a cardiac CT angiography. (Figure 3)

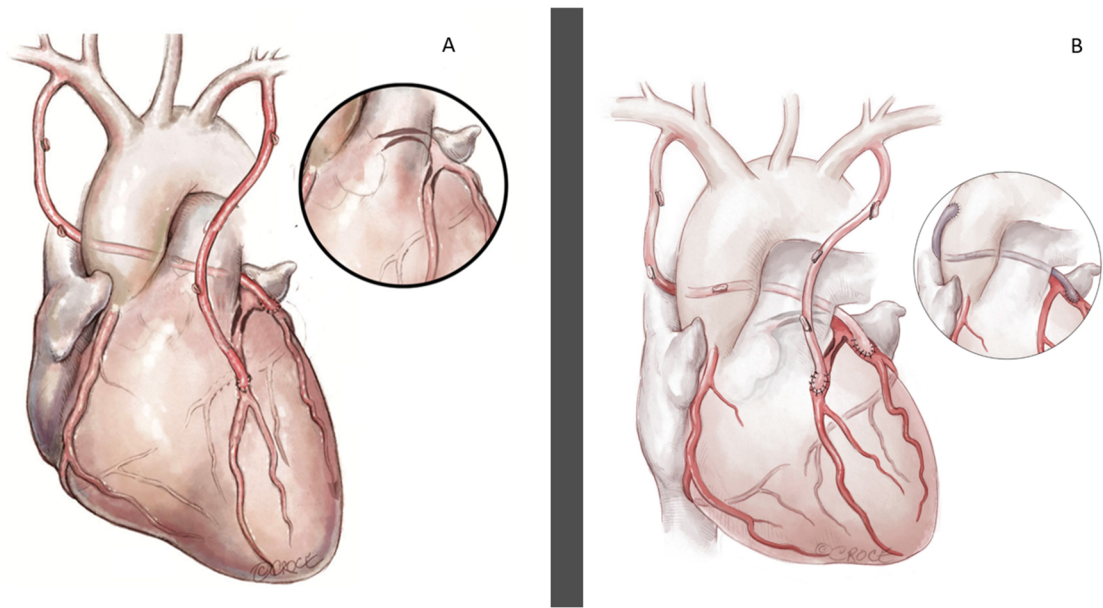


Figure 2. A: Arterial vascularization with RITA on circumflex trunk.B: If a vein graft is selected, it should be positioned on the anterolateral part of the aorta to minimize the risk of kinking.

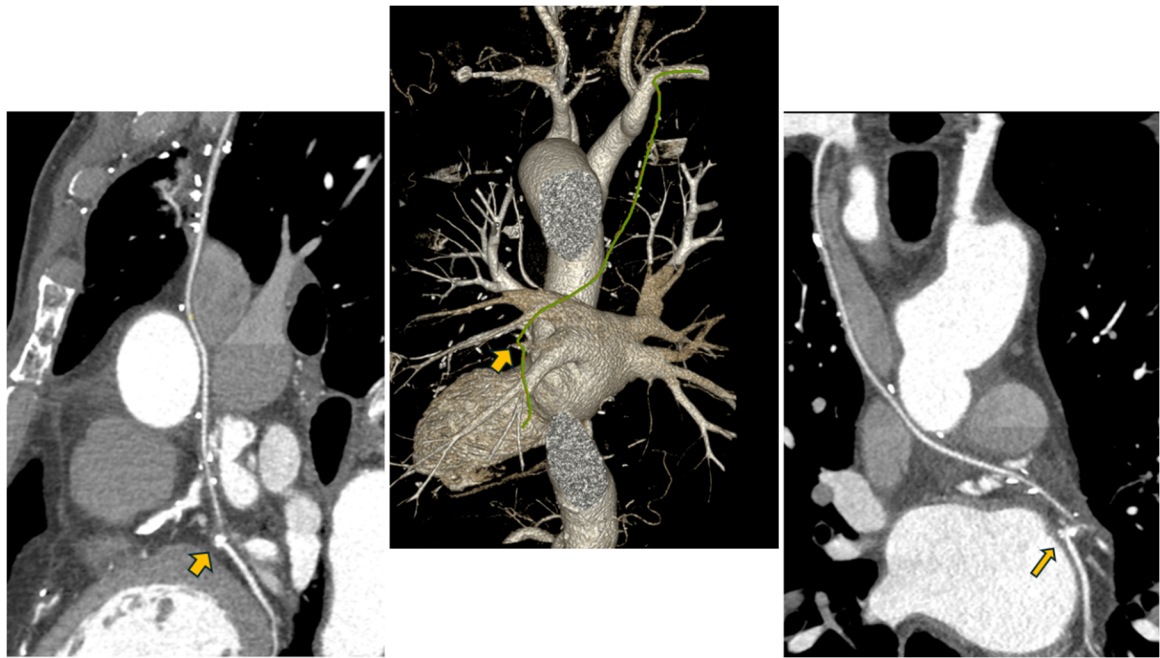


Figure 3. Post-operative computed tomography assessment of the RITA-Circumflex artery direct vascularization one year after surgery. **Left:** Sagittal thoracic CT slice demonstrating patency of the circumflex coronary artery. **Middle:** Three-dimensional volume-rendered reconstruction highlighting the retro-aortic course of the RITA, with an unobstructed trajectory, absence of kinking, and the characteristic "cobra head" anastomotic configuration. **Right:** Retro-aortic pathway of the RITA, anastomosed to the circumflex artery at the site indicated by the arrow.

3. Discussion

The circumflex territory presents one of the most technically challenging areas to revascularize [2]. Typically, grafts are connected to the marginal branches rather than directly to the circumflex artery itself. This approach often necessitates multiple jump anastomoses, two or three, on small-caliber vessels, frequently requiring intricate angulations. Achieving adequate exposure of these branches can be difficult, especially given the distorted anatomy of a twisted heart in an atypical

surgical plane. Consequently, the risk of developing anastomotic stenosis is significantly higher compared to anastomoses performed on larger, well-exposed vessels.

From an anatomical point of view, the circumflex artery is, for most of its course, buried in the atrioventricular groove fat, under the coronary sinus, making its approach impracticable. However, a proximal segment of approximately 15 millimeters remains relatively superficial, covered only by fat tissue, before the artery dives deeper near the emergence of the left atrial appendage. Indeed, there is an additional time required to expose the circumflex artery trunk. It is, however, well compensated with the avoidance of many distal anastomoses necessary with a conventional approach

The right internal thoracic artery can be routed without tension or length constraints through the transverse sinus to align seamlessly with the circumflex trunk. Alternatively, a free graft, using the radial artery or a segment of saphenous vein, may be employed. It should not, however, be inserted as a side-branch on the LITA but rather on the antero-lateral part of the ascending aorta and brought through the transverse sinus to the circumflex artery, to prevent kinking.

A critical advantage of our technique is the avoidance of flow competition frequently observed in composite graft configurations, such as T or Y anastomoses. In such constructs, disparities in vascular resistance between the LAD and marginal branches can lead to imbalanced perfusion and potentially suboptimal graft flow. By providing independent inflow from the RITA routed through the transverse sinus, our approach offers more controlled and physiological antegrade perfusion to the circumflex territory. Moreover, although concerns are often raised regarding the limited reach of the RITA to the marginal branches, we demonstrate that, when routed through the transverse sinus, the RITA can be safely and reliably anastomosed to the proximal circumflex trunk without tension or kinking. This alignment not only preserves graft integrity but also facilitates surgical access and anastomotic precision. Importantly, we do not propose this as a universal alternative, but rather as an adjunctive strategy in selected patients, particularly those in whom total arterial revascularization is desirable and the proximal circumflex segment is accessible.

Our technique provides a more physiological and shorter revascularization route, ensuring homogeneous perfusion to the entire circumflex territory and potentially enhancing long-term graft patency.

However, this approach has specific limitations. Performing the anastomosis on a beating heart in this postero-lateral region can be technically demanding due to the difficulty in stabilizing the proximal circumflex trunk and maintaining adequate exposure. Moreover, the procedure should not be attempted if the distal marginal branches are diseased, as competitive flow obstruction may compromise overall perfusion. Anatomical factors such as a deeply intramural circumflex course, excessive calcification, or limited space between the left atrium and pulmonary veins may also limit feasibility.

An additional advantage of this surgical strategy lies in its superiority over hybrid revascularization approaches, in which a MIDCAB for the LAD is combined with percutaneous stenting of the circumflex artery. While the latter remains an attractive option in selected cases, stent patency in the circumflex territory has been shown to be inferior to that achieved with surgical grafting, particularly in diffusely diseased or calcified vessels. Future prospective evaluation in a larger cohort will be necessary to confirm the reproducibility, safety, and durability of this approach.

4. Conclusion

Using the proximal circumflex trunk for revascularization offers a streamlined alternative to multiple distal anastomoses, ensuring natural antegrade blood flow across the entire territory. This approach minimizes technical challenges and risks associated with grafting small, difficult-to-access branches. In suitable cases, it provides a safe, efficient, and durable solution, redefining strategies for complete revascularization in complex coronary scenarios.

Supplementary Materials: The following supporting information can be downloaded at the website of this paper posted on Preprints.org. **Video 1:** How to achieve an elegant direct circumflex revascularization in isolated left main disease.

Informed Consent Statement: The patient gives his written consent for the publication of the photography and video. Ethics committee approval has been waived since the manuscript is based on a single case report with a full anonymized data.

Data Availability Statements: The data underlying this article are available in the article and in its online supplementary material.

Abbreviations

LAD	Left anterior descending artery
LITA	Left internal thoracic artery
RITA	Right internal thoracic artery
CPB	Cardiopulmonary bypass

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