



Surgical coronary angioplasty with common femoral artery and coronary artery bypass grafting for the treatment of left main coronary artery aneurysm outside the stent: a case report

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Background: Managing coronary artery aneurysms (CAAs), especially those outside stents, is a considerable clinical challenge. The optimal material for coronary artery patch plasty is not well-established. This report illustrates a novel approach using the common femoral artery (CFA) for coronary patch plasty and concurrent coronary artery bypass grafting (CABG) in the case of a symptomatic CAA in the left main coronary artery (LMCA) outside the stent.

Case Description: A 51-year-old male initially presented with exertional angina. Imaging revealed a giant ulcerated aneurysm in the LMCA and total occlusion at the ostium of the proximal left anterior descending artery (LAD). He underwent percutaneous coronary intervention (PCI) that included directional coronary atherectomy (DCA) of the proximal LAD and stenting from LMCA to mid-LAD. This procedure alleviated his symptoms. The patient was put on dual antiplatelet therapy (DAPT) and statin but ceased follow-up and medication one-year post-PCI. Three years post-PCI, the patient returned with exertional chest discomfort and dyspnea. Further imaging showed the enlargement of the known LMCA ulcer/aneurysm outside the stent but no new stenotic lesion in the stent or the native coronary arteries. The heart team decided on surgical intervention. The patient underwent coronary patch plasty with a CFA and CABG, utilizing left internal thoracic artery (LITA)-LAD and aorto-saphenous vein graft (Ao-SVG)-left circumflex artery (LCX).

Conclusions: This case suggests surgical coronary angioplasty using a CFA, along with CABG, can be a promising treatment option for managing symptomatic LMCA aneurysms located outside stents. However, further studies are needed to verify the safety and efficacy of this approach in a larger patient population.

Keywords: Surgical coronary angioplasty; coronary artery aneurysm (CAA); left main coronary artery (LMCA); coronary artery bypass grafting (CABG); case report

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Introduction

Coronary artery aneurysms (CAAs), particularly those in the left main coronary artery (LMCA), are uncommon clinical entities (1,2) that can pose significant diagnostic and management challenges. Treatment options are not well-defined due to the lack of extensive research data and the anatomical complexities of these aneurysms (1,3,4). In this report, we present an unusual case of an expanding symptomatic CAA in the LMCA outside the stent. The successful management was achieved using coronary artery patch plasty with a patch from the common femoral artery (CFA), a novel approach, in conjunction with coronary artery bypass grafting (CABG). This case introduces the potential of the CFA patch in coronary angioplasty, especially in complex cases involving CAAs outside stents, adding valuable insight to this limited area of research. We present this case in accordance with the CARE reporting checklist (available at <https://jovs.amegroups.com/article/view/10.21037/jovs-23-10/rc>).

Case presentation

Case (Figures 1,2, Video 1)

A 51-year-old Japanese male presented with exertional chest

pain during flat-ground walking for the past three months. He had visited a hospital earlier, where electrocardiographic changes were noted, leading to a referral to our hospital for further evaluation. T-wave flattening was observed in leads I, aVL, and V5–6. The patient had a family history of angina in his brother. Cardiac computed tomography angiography (CTA) revealed a large aneurysm in the LMCA and suspected occlusion in the proximal left anterior descending artery (LAD), along with possible stenosis in the left circumflex artery (LCX) (Figure 1A,1B).

Consequently, a diagnosis of effort angina was made, and the patient was admitted for investigation. Cardiac catheterization revealed a giant ulcerated CAA in LMCA, total occlusion of the proximal LAD, and 75% stenosis in the LCX identified (Figure 2A). Collateral circulation to the distal LAD was noted from the right coronary artery and the distal branches of the circumflex artery (Figure 2B). The patient underwent percutaneous coronary intervention (PCI) for the chronic occlusive lesion in the LAD artery, including directional coronary atherectomy (DCA) performed for the proximal LAD occlusion, followed by stent placement from LMCA entrance to the mid-LAD, using an everolimus-eluting stent (Figure 2C). Dual antiplatelet therapy (DAPT) with aspirin and clopidogrel, as well as statin therapy, were initiated. Post-PCI, the patient experienced relief from chest symptoms. However, after one year, the patient discontinued outpatient visits and medication. Three years after the PCI, the patient presented to the hospital with chest discomfort, dyspnea, and nausea during walking for his daily commute. Cardiac CTA showed enlargement of the CAA of the LMCA outside the stent but no stenosis within the stent, but LCX appeared jailed by the stent, suggesting possible stenosis (Figure 1C-1F).

Consequently, the patient was admitted for further evaluation. On the same day, catheterization revealed no new stenotic lesions in the stent or native coronary artery. However, an enlargement of the pre-existing massive ulcer/aneurysmal lesion outside the stent in LMCA was noted (Figure 2D). Plaque rupture at the site of the CAA in LMCA was suspected of causing the current episode of unstable angina. The case was discussed with the heart team. Considering the patient's young age and the need to prevent future cardiovascular events, the intervention was deemed necessary. Since a covered stent that could adequately fit the large lesion was unavailable, surgical treatment was deemed appropriate.

Highlight box

Key findings

- This case report describes the successful surgical management of a left main coronary artery (LMCA) aneurysm located outside the stent using coronary artery patch plasty with the common femoral artery (CFA) and coronary artery bypass grafting (CABG).

What is known and what is new?

- Surgical coronary artery plasty has been established as a valid treatment option for patients with symptomatic coronary artery aneurysms (CAAs). Various materials are utilized for patch plasty, yet the optimal choice remains under study.
- We report the innovative use of a CFA patch in coronary angioplasty for managing a CAA outside the stent in the LMCA. This expands the therapeutic options, although further research is required to validate its safety and efficacy on a larger scale. Implication: The application of CFA in surgical coronary angioplasty, coupled with CABG, could represent a valuable strategy for managing LMCA aneurysms outside stents.

What is the implication, and what should change now?

- The application of CFA in surgical coronary angioplasty, coupled with CABG, could represent a valuable strategy for managing LMCA aneurysms outside stents.

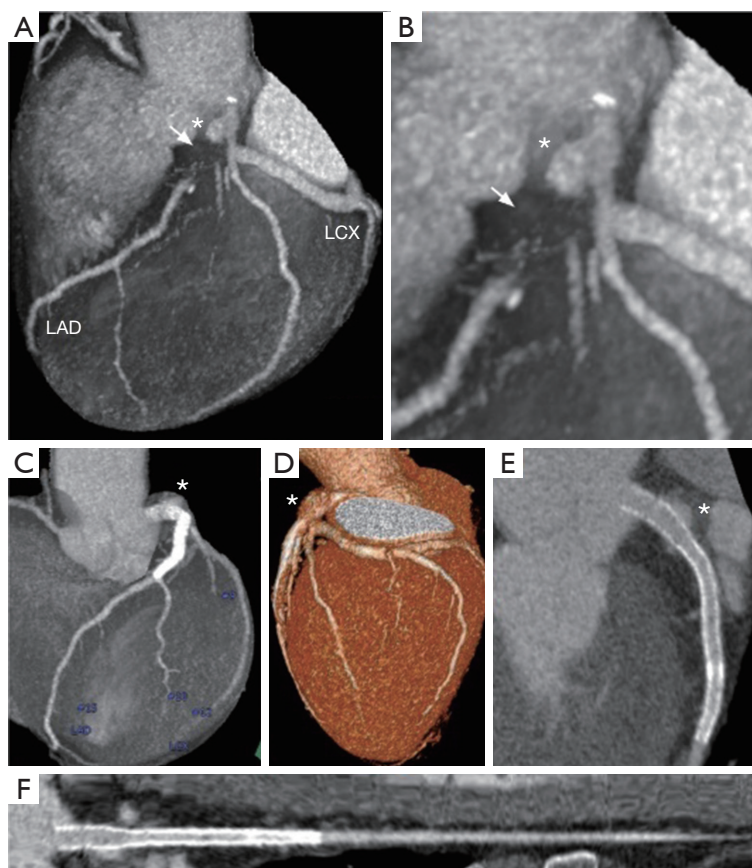


Figure 1 CTA of the LCA. This figure presents a series of CT angiograms capturing the LCA at various time points. An asterisk (*) has been utilized to emphasize the presence of a coronary aneurysm in all images, while proximal LAD occlusion is explicitly indicated by an arrow in (A) and (B). (A) At the age of 51 years, during the initial presentation for exertional chest pain, a VR 3D image displays the LMCA aneurysm (asterisk) and proximal LAD occlusion (arrow). (B) A magnified view of (A). (C,D) At age 54 years, 3 years after the initial PCI, the patient presented with recurrent chest pain. These VR 3D images portray the enlargement of the LMCA aneurysm from different angles. (E) Stretched CPR and (F) straight CPR images of the LCA provide further clarity regarding the enlarged LMCA aneurysm, without any evidence of in-stent or native coronary artery stenosis. LCX, left circumflex artery; LAD, left anterior descending artery; CTA, computed tomography angiography; LCA, left coronary artery; CT, computed tomography; VR, volume-rendered; LMCA, left main coronary artery; PCI, percutaneous coronary intervention; CPR, curved planner reconstruction.

Surgery (Figure 3, Video 2)

Under general anesthesia, a median sternotomy was performed, and the CFA and great saphenous vein were obtained from the right groin and thigh, respectively. The CFA, which had a diameter of 1.2 cm, was harvested at a length of 4.5 cm and substituted with an 8 mm expanded polytetrafluoroethylene/polyethylene terephthalate (PTFE/PET) prosthetic graft Fusion (Getinge, Gothenburg, Sweden). The excised CFA was opened longitudinally to create a 4.5 cm × 4 cm plate used as a patch. Left internal thoracic artery (LITA) was harvested. After systemic heparinization, cardiopulmonary bypass was initiated

with aorto-bicaval cannulation. Retrograde cardioplegia induced cardiac arrest and the ascending aorta was cross-clamped. Distal anastomosis of saphenous vein graft (SVG) was made with the obtuse marginal (OM) branch of the LCX. The left coronary artery (LCA) ostium was exposed by transecting the ascending aorta at the level of the sinotubular junction (STJ). Examination of the LCA ostium from within the aortic lumen revealed a stent protruding through the ostium. After dissecting the left coronary sinus, an aneurysm of LMCA was detected, and the left coronary sinus was opened towards the LCA ostium. The LCA was then opened, beginning over the stents from the LMCA

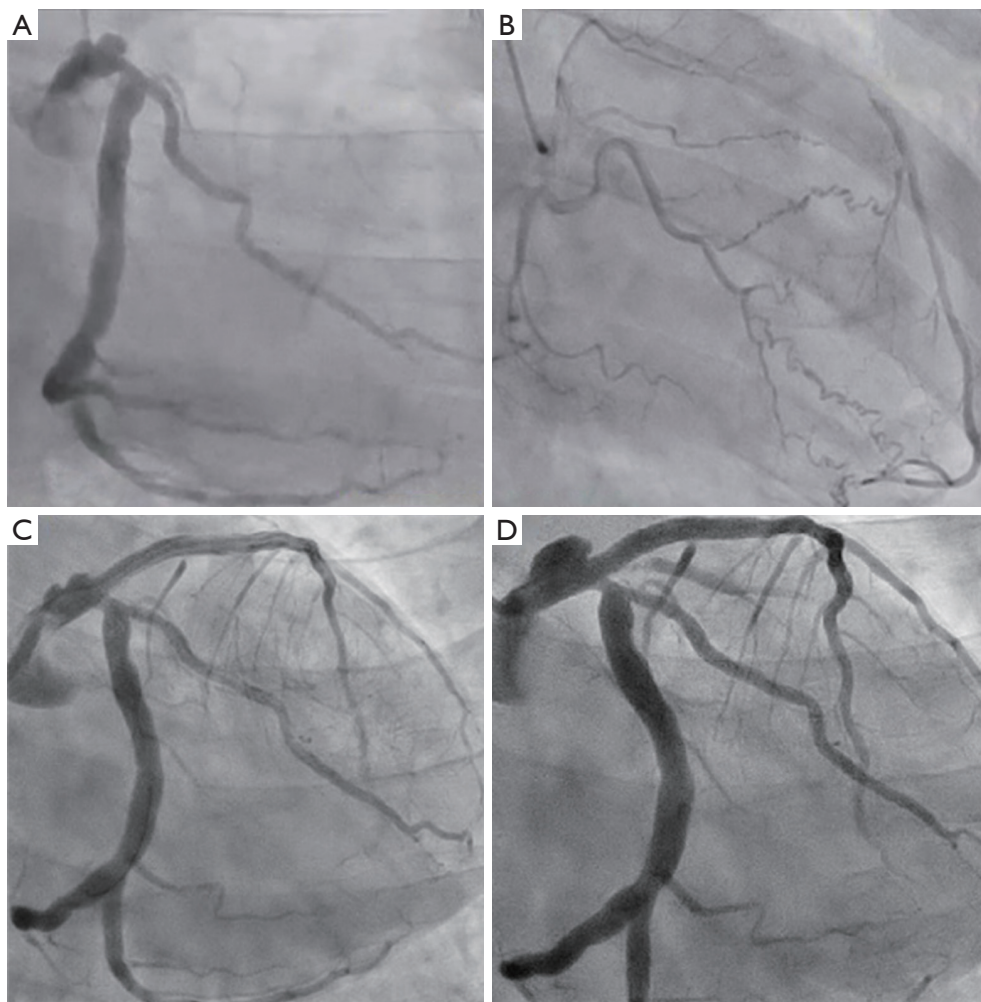


Figure 2 CAG of the left coronary artery. This figure presents a series of CAG at various time points. At age 51 years, the patient presented with chest pain. (A) Initial CAG revealed an LMCA aneurysm with LAD ostial occlusion, while collateral circulation from LCX to the peripheral LAD was observed (B). Subsequently, an everolimus-eluting stent was deployed from LMCA to mid-LAD, as depicted in (C), immediately post-PCI. At age 54 years, 3 years after the initial PCI, the patient presented with recurrent chest pain. CAG illustrated an enlarged LMCA aneurysm with ulceration, no in-stent restenosis, and a 50% stenosis, jailing the LCX (D). CAG, coronary angiography; LMCA, left main coronary artery; LAD, left anterior descending artery; LCX, left circumflex artery; PCI, percutaneous coronary intervention.

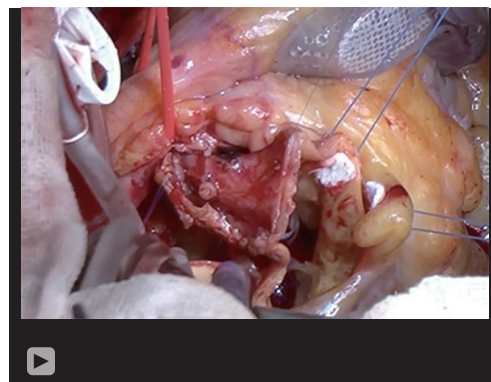
to the LAD. A pale red thrombus was observed in the aneurysm of the LMCA (*Figure 3A,3B*). The stents in the LAD were longitudinally opened, and all but the section of the stent covering the ostium of LCX was extracted along with a thin membrane (*Figure 3C*).

The CFA patch, measuring 4.5 cm × 4 cm, was sutured from the distal side of the coronary opening of the LAD towards the LMCA with a running suture utilizing 6-0 monofilament. The patch with the aortic wall was then continued with a 5-0 monofilament running suture

(*Figure 3D*). The most distal part of the CFA patch with the LAD opening was intentionally constricted using five buttressed U-stay sutures with autologous pericardium on the patch side and felt pledget on the LAD side (*Figure 3E*). Subsequently, CABG was performed, including the anastomosis of LITA to the mid-LAD. After the reconstruction of the ascending aorta, SVG was anastomosed in the ascending aorta. After administering a hot shot through the root cannula, the cross-clamp was released. The graft flow was measured at LITA-LAD flow



Video 1 Case presentation.



Video 2 Surgical coronary angioplasty of LMCA aneurysm with CFA patch and CABG. LMCA, left main coronary artery; CFA, common femoral artery; CABG, coronary artery bypass grafting.

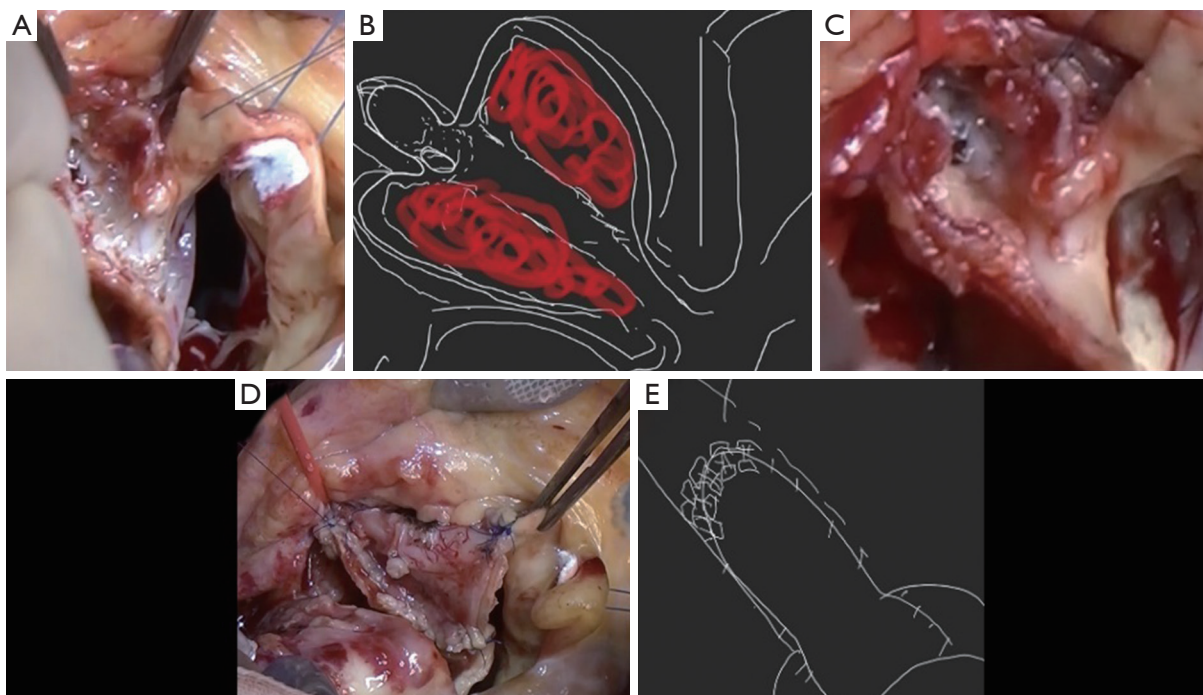


Figure 3 Intraoperative observations. (A) Following the LMCA incision, a pale-red thrombus was identified within the LMCA aneurysm exterior to the stent. (B) Detailed view of the thrombus. (C) Removal of the stent except for the segment covering the LCX orifice. (D) LMCA reconstruction using an autologous CFA patch. (E) Intentional constriction of the LAD. LMCA, left main coronary artery; LCX, left circumflex artery; CFA, common femoral artery; LAD, left anterior descending artery.

5.1/pulsatility index (PI) 10 and SVG-OM flow 4.4/PI 25.

Postoperative study (Video 3)

Postoperative cardiac CTA (Figure 4) and coronary

angiography (CAG) (Figure 5) confirmed the success of coronary patch angioplasty and CABG. 3D reconstruction (Figure 4A,4B) and curved planner reconstruction (CPR) (Figure 4C) of CTA (Figure 4) revealed a 10 mm dilation at the angioplasty site of LMCA with CFA. All bypass

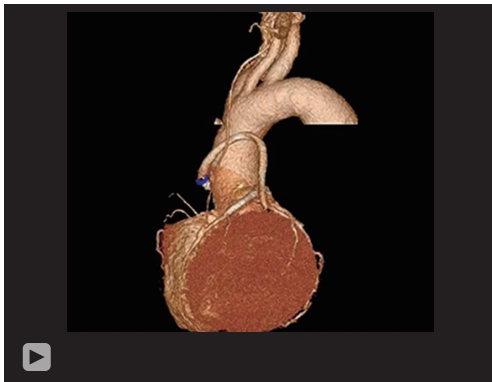
grafts were patent; however, there was poor development of LITA to LAD bypass (*Figure 4D*). CAG (*Figure 5A,5B*) showed smooth vessel walls and patent grafts. The LITA-LAD bypass appeared to exhibit a to-and-fro flow pattern, suggesting it was competitive with the native flow of the LAD, which was found to be well-maintained.

Postoperative course

The patient was discharged in good postoperative condition on the eleventh day after the operation.

The patient remained symptom-free for 1 year and 9 months postoperatively.

All procedures performed in this study were in



Video 3 Postoperative study.

accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this case report, accompanying images and videos. A copy of the written consent is available for review by the editorial office of this journal.

Discussion

This case report highlights the successful management of a symptomatic CAA located outside the stent in the LMCA using coronary patch plasty with CFA and CABG.

This case report presents a complex case for several reasons. Firstly, the aneurysm was located outside the stent, which posed a challenge for treatment. Additionally, the patient had an LMCA aneurysm with total occlusion of the LAD, which was treated with PCI using DCA and stenting that jailed the ostium of the LCX. Finally, there was the absence of in-stent restenosis.

Given these factors, the authors conducted coronary angioplasty of the LMCA using a CFA patch after removing the stents, except those overlaying the LCX ostium. Additionally, CABG was performed using LITA-LAD and an aorta-SVG (Ao-SVG)-LCX. The authors also employed additional sutures to induce stenosis in the LAD ostium to avoid flow competition.

Various materials can be used for coronary angioplasty

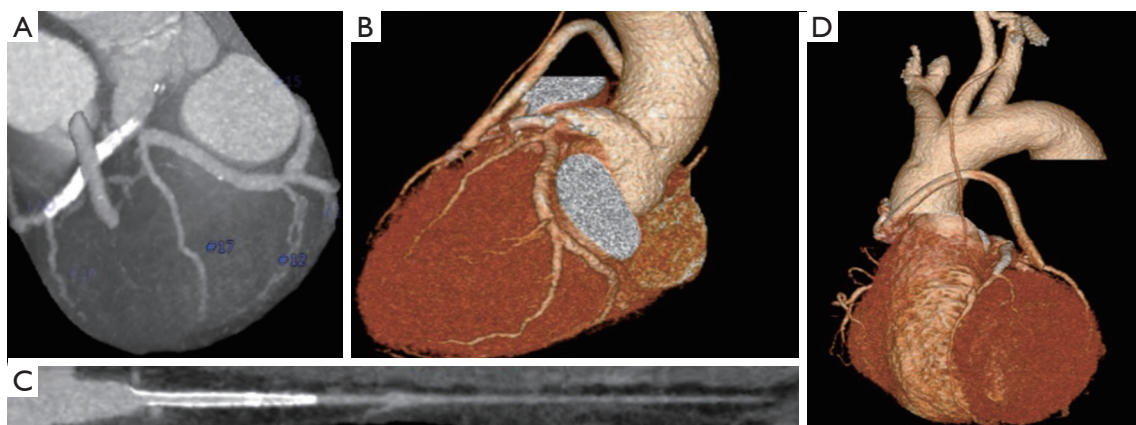


Figure 4 Postoperative 3D and CPR reconstruction of CT angiogram. (A,B) 3D reconstruction from different angles showed patent bypass grafts. (C) Straight CPR of the LCA showed a 10 mm dilation at the angioplasty site of LMCA with CFA. (D) 3D reconstruction image showed poorly-developed LITA bypassed to LAD. 3D, three dimensional; CPR, curved planner reconstruction; CT, computed tomography; LCA, left coronary artery; LMCA, left main coronary artery; CFA, common femoral artery; LITA, left internal thoracic artery; LAD, left anterior descending artery.

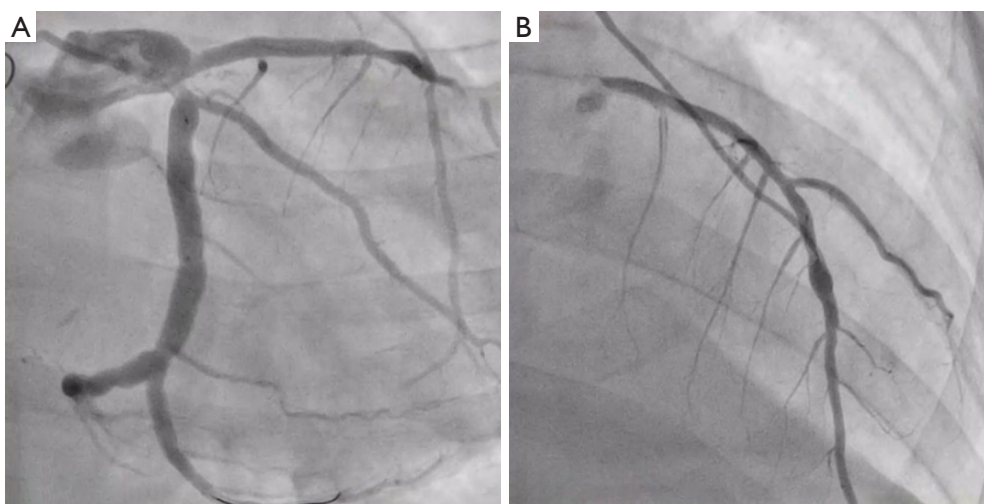


Figure 5 Postoperative CAG. (A) An angiogram of the LMCA angioplasty site showed a smooth intimal surface. (B) LITA is well patent. CAG, coronary angiography; LMCA, left main coronary artery; LITA, left internal thoracic artery.

patches, such as the saphenous vein, pericardium, internal thoracic artery, pulmonary artery, and superficial femoral artery (5-7). In this case report, the CFA was utilized as a patch for the first time. This decision was based on several factors, including the material's availability, handling characteristics, and antithrombogenicity. Additionally, it was found to be easy to apply to the aortic wall and capable of withstanding arterial pressure, ensuring graft function with minimal degenerative changes compared to other options such as autologous pericardial patches or SVGs, which have a potential to fail at a later stage (5).

One of the most critical issues in coronary angioplasty involving the coronary ostium is patch kinking, which can disrupt coronary artery flow and lead to severe myocardial ischemia. Fortunately, the current technique allowed for satisfactory coronary artery enlargement without patch kinking and ensured adequate coronary artery flow. The autologous superficial femoral artery (6,7) and femoral artery homograft (8,9) have been reported to be successfully used for coronary ostial plasty in patients with Takayasu's arteritis and in young adults with congenital heart disease, respectively. Nonetheless, it is essential to evaluate the aortic root and coronary arteries by monitoring the clinical course of patients treated with autologous CFA patch grafts in the coronary ostium and the sinus of Valsalva.

Because in-stent restenosis has not been observed, performing CABG on the distal segment of the coronary arteries is challenging due to flow competition between the native coronary arteries and the grafts (10,11). To mitigate

this, we introduced sutures to induce stenosis in the LAD, which could aid in sustaining graft flow, especially in the early postoperative period. However, complete excision or ligation of the aneurysm with bypass may serve as an alternative option, although the failure of the LITA-LAD can be rare but hazardous in case the LMCA were to become occluded.

Given the increase in thrombogenicity in the early postoperative period and the exposed state of the CFA patch, we had concerns about the risk of thrombus formation and occlusion at the coronary aneurysm repair site. To mitigate this risk, we implemented intensified antithrombotic therapy postoperatively. Moreover, to prevent cardiovascular events during the early postoperative period when the risk of thrombotic occlusion is high, we performed CABG on the distal LAD, the repair site.

Although the patency of the LITA-LAD is good, it could be potentially fatal if an occlusion occurred, leading to a widespread myocardial infarction due to acute LAD occlusion. To avoid such a scenario, we performed CABG. Three months postoperatively, we expect the coronary artery repair site to be covered with neointima, reducing thrombogenicity. To ensure the patency of the bypass during this period, we intentionally created a stenosis on the central side of the LAD anastomosis site, which had no stenosis.

Postoperative imaging revealed competitive flow, which is a favorable result, but long-term follow-up is essential. Currently, one year and nine months have

passed postoperatively, and the patient is symptom-free. If symptoms recur, we will consider evaluating with imaging. As for antithrombotic therapy, based on past experiences with coronary patch angioplasty (Taksnashi S. Personal communication. February 19, 2022), we plan to administer DAPT plus warfarin for three months postoperatively, DAPT for up to one year, and single antiplatelet therapy (SAPT) thereafter.

This case report's findings should be interpreted in light of several limitations. Primarily, the report represents a single patient's experience, which may not generalize to all patients with similar conditions. The longer-term outcomes and durability of the applied procedures, including using the femoral artery as a patch and CABG, are unknown and require further investigation. Deliberately constricting the LAD ostium to avoid flow competition also needs additional evaluation for its general applicability and potential complications. Hence, while the case offers valuable insights, larger studies and longer follow-up periods are essential for a comprehensive understanding and validation of these treatment strategies.

Conclusions

In conclusion, surgical coronary angioplasty with the CFA and coronary bypass grafting for an LMCA aneurysm outside the stent was successful. The CFA patch represents a promising option for coronary angioplasty patches, and sutures may be used to induce stenosis in the LAD ostium to mitigate flow competition. However, further research is necessary to confirm the safety and efficacy of this approach in larger patient populations.

Coronary patch angioplasty with CFA and coronary bypass grafting for an LMCA aneurysm outside the stent was successful.

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Footnote

Reporting Checklist: The authors have completed the CARE reporting checklist. Available at <https://jovs.amegroups.com/article/view/10.21037/jovs-23-10/rc>

Peer Review File: Available at <https://jovs.amegroups.com/article/view/10.21037/jovs-23-10/prf>

Conflicts of Interest: Both authors have completed the ICMJE uniform disclosure form (available at <https://jovs.amegroups.com/article/view/10.21037/jovs-23-10/coif>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for the publication of this case report, accompanying images, and videos. A copy of the written consent is available for review by the editorial office of this journal.

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