

CORONARY, PERIPHERAL, AND STRUCTURAL INTERVENTIONS

CLINICAL CASE

High-Risk Left Main Angioplasty With Covered Stent in Marfan Patient With Hemi-Cabrol Surgery



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ABSTRACT

INTRODUCTION The Cabrol procedure is a complex surgical technique with potential complications, including graft stenosis. We report a successful percutaneous coronary intervention using a peripheral covered stent to treat Cabrol graft stenosis.

CASE PRESENTATION A 49-year-old male with Marfan syndrome and prior aortic surgery, including a hemi-Cabrol graft to the left main artery, presented with angina and dyspnea. Imaging revealed severe stenoses in the Cabrol-left main artery anastomosis and right coronary artery ostium. Percutaneous coronary intervention (PCI) was performed for the right coronary artery with a drug-eluting stent, followed by PCI for the Cabrol graft using a 7- × 26-mm covered stent via brachial access.

OUTCOMES The procedure was successful, with no complications. At 2-year follow-up, the patient remains asymptomatic, with preserved function and no restenosis.

CONCLUSION PCI with a peripheral covered stent is a feasible, less-invasive alternative to surgery for Cabrol graft stenosis, offering favorable outcomes in high-risk patients. (JACC Case Rep. 2025;30:103694) © 2025 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

HISTORY OF PRESENTATION

A 49-year-old male presented to an outpatient clinic with complaints of new-onset Canadian Cardiovascular Society grade III angina and exertional dyspnea

classified as NYHA functional class II. On physical examination, he was stable, with a blood pressure of 124/80 mm Hg and a heart rate of 80 beats/min. Cardiac auscultation revealed a 2+/6+ ejection murmur over the aortic area without radiation.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the [Author Center](#).

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ABBREVIATIONS AND ACRONYMS

CTA = computed tomography angiography

CX = circumflex artery

LAD = left anterior descending artery

LMA = left main artery

PCI = percutaneous coronary intervention

RCA = right coronary artery

Jugular venous pressure was not elevated, lung auscultation was clear bilaterally, and there was no peripheral edema.

PAST MEDICAL HISTORY

The patient's medical history is significant for Marfan syndrome, diagnosed in 1993, for which he underwent repair of an ascending aortic aneurysm at age 19 years with the placement of a Dacron graft and a mechanical aortic valve prosthesis. In 2018, the patient had cavotricuspid isthmus ablation for recurrent atrial fibrillation/flutter. In 2021, a routine computed tomography angiography (CTA) revealed a pseudoaneurysm in the Dacron tube with signs of imminent rupture, necessitating urgent surgery. This surgery involved replacing the Dacron tube, placing a new mechanical valve, and reimplanting the left main artery (LMA) using a modified hemi-Cabrol technique, which involved a 10-mm tube graft to the LMA (Figure 1). The right coronary artery (RCA) was reimplanted directly into the new aortic tube (Figure 1). The patient was discharged on atenolol 150 mg daily and warfarin with adjustments based on prothrombin time.

TAKE-HOME MESSAGES

- Cardiologists must be familiar with Cabrol and modified Cabrol surgical techniques and their anatomical considerations.
- Cabrol graft PCIs might be an essential treatment option in such high-surgical risk patients, especially after multiple thoracic surgical approaches.
- Careful procedural planning, including coronary angiography and CTA, is paramount in such patients.

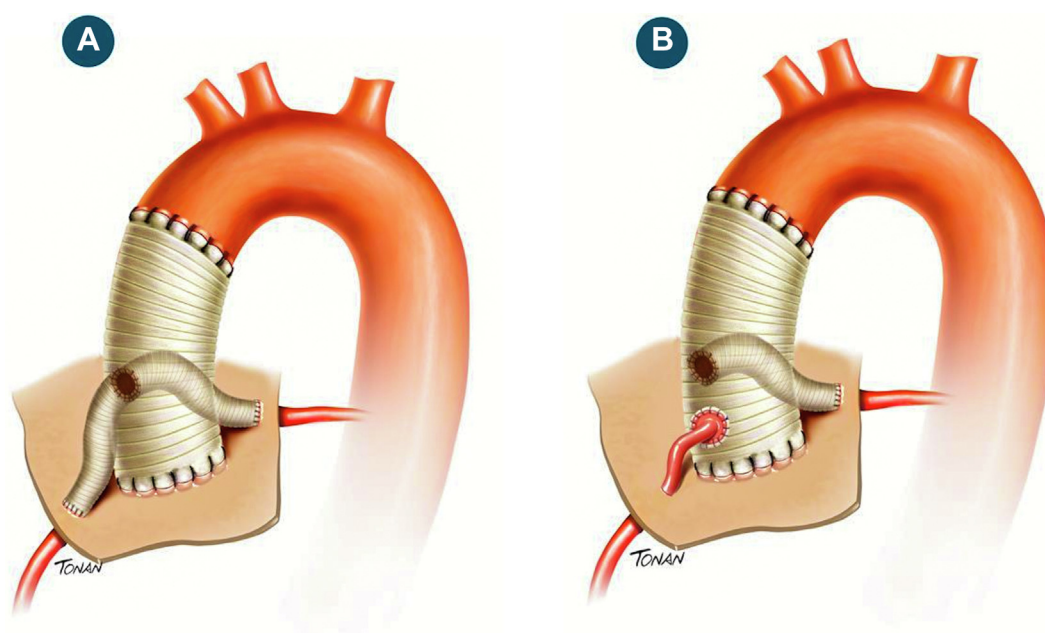
DIFFERENTIAL DIAGNOSIS

The patient's symptoms suggested several possible causes, including coronary artery disease, dysfunction of the mechanical valve, coronary anastomotic stenosis, nonanginal chest pain, and recurrent atrial arrhythmias.

INVESTIGATIONS

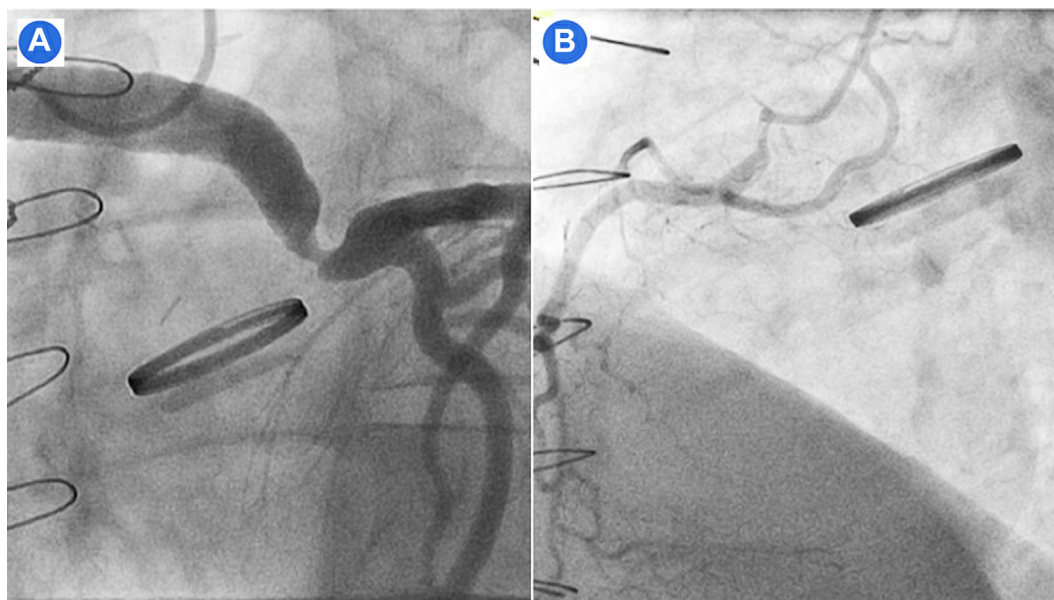
Given the chest pain and heart failure symptoms, a transthoracic echocardiogram was performed, revealing significant right atrial dilation (64 mL/m²),

FIGURE 1 Techniques



Cabrol technique (A) and hemi-cabrol technique (B).

FIGURE 2 Coronary Angiography



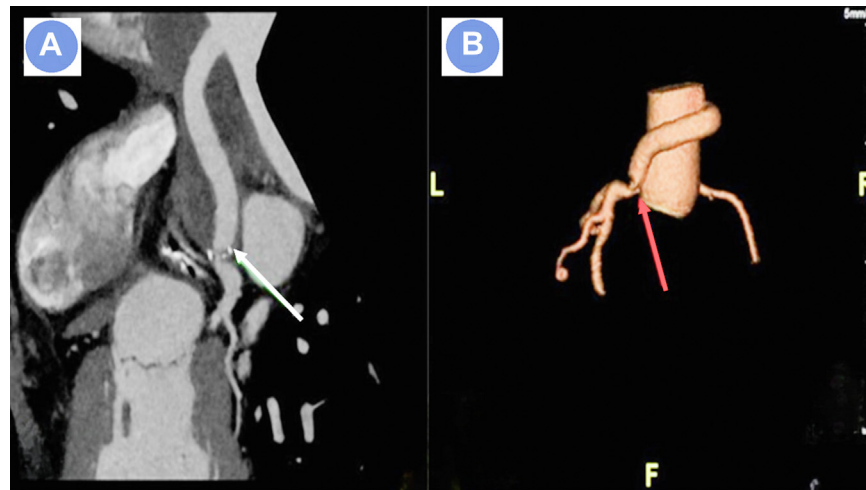
Coronary angiography showed a severe lesion at the anastomosis of the hemi-Cabrol graft to the LMA (A) and a severe lesion in the RCA (B). LMA = left main artery; RCA = right coronary artery.

diffuse left ventricular hypokinesia with an ejection fraction of 46% (Simpson's method), and normal right ventricular systolic function. The mechanical aortic valve showed normal function, with mild central regurgitation and maximum and mean gradients of 19 mm Hg and 9 mm Hg, respectively. Myocardial perfusion imaging (single-photon emission computed tomography) using stress sestamibi revealed reduced uptake in the apical and inferior walls. Coronary angiography showed a severe lesion at the anastomosis of the hemi-Cabrol graft to the LMA ([Figure 2A](#)) and a severe lesion in the RCA ([Figure 2B](#)). An aortic angiography confirmed normal prosthesis function with no complications. An additional CTA of the aorta revealed a small ectasia of the ascending aorta (42 × 40 mm) and a significant luminal reduction at the anastomosis of the LMA to the Dacron graft ([Figures 3A and 3B](#)), in addition to severe stenosis at the RCA ostium.

MANAGEMENT

After careful evaluation by the heart team, percutaneous coronary intervention (PCI) was undertaken to treat the severe lesions in the function of multiple interventions and high surgical risk. Therefore, PCI to

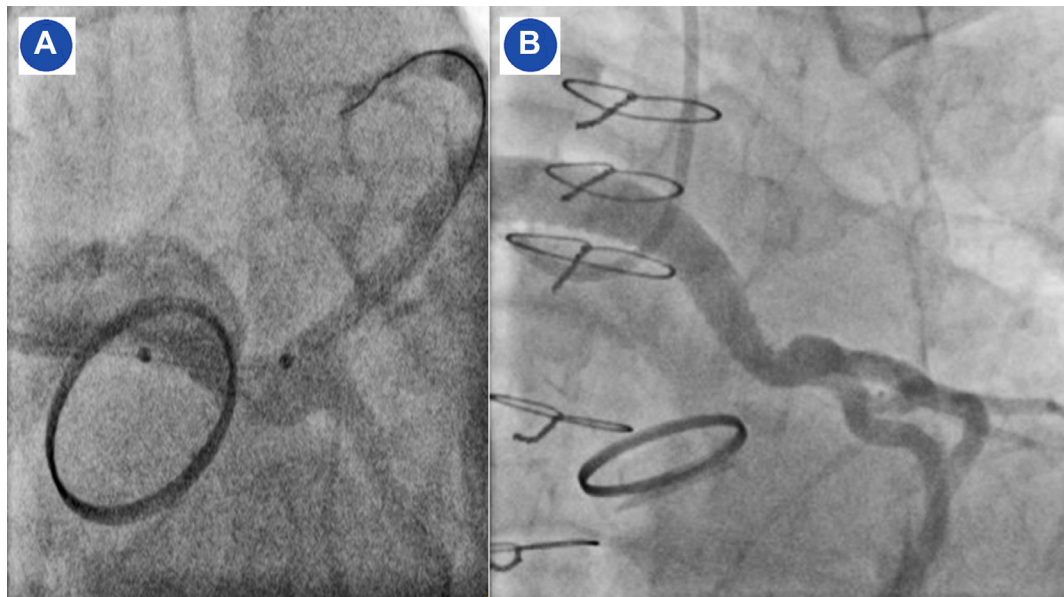
the RCA anastomosis was initially performed using a transradial approach and a multipurpose 6-F guiding catheter, with the implantation of a 4- × 19-mm drug-eluting stent and subsequent postdilation with a 4- × 12-mm noncompliant balloon at 20 atm. After an uneventful procedure, the patient was discharged after 2 days, but the 4-month follow-up persisted with the symptoms. Therefore, PCI to LMA-Cabrol interposition was performed ([Video 1](#)). Due to the large bore catheter needed for the covered peripheral stent, a right brachial artery cutdown was undertaken, and selective Cabrol catheterization was performed with an 8-F AL-1 catheter. Using the buddy-wire technique, 1 V-18 (0.018-inch) guidewire was placed in the left anterior descending artery (LAD) and a 0.014-inch BMW guidewire went to the distal circumflex artery (CX). Predilatation of the anastomotic lesion with a 5- × 15-mm noncompliant balloon was performed at 16 atm. Subsequently, through the LAD guidewire, a 7- × 26-mm LifeStream Balloon Expandable Vascular Covered Stent was deployed at the transition of the Dacron graft and the LMA ostium at 12 atm ([Figure 4A](#)). Finally, postdilation was performed with a 9- × 40-mm Conquest balloon at 14 atm. Final angiography confirmed TIMI flow grade 3 without complications ([Figure 4B](#)). After an

FIGURE 3 Significant Luminal Reduction

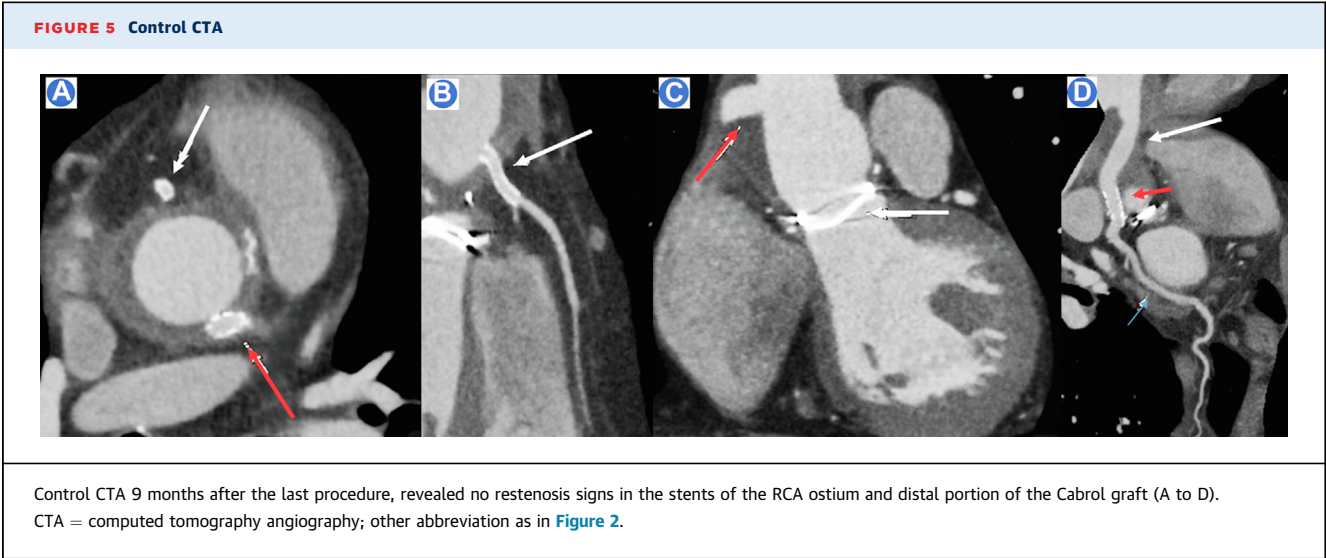
Significant luminal reduction at the anastomosis of the LMA to the Dacron graft (A) in addition to a severe stenosis at the RCA ostium (B). Abbreviations as in [Figure 2](#).

uneventful hospital stay, the patient was discharged on day 6 with a triple-therapy regimen: aspirin, clopidogrel, and warfarin for 1 month. This was followed by dual-therapy with clopidogrel and warfarin for 1

year, in accordance with most guidelines for stable coronary disease. At a 2-year follow-up, the patient is asymptomatic with a normal left ventricular ejection fraction.

FIGURE 4 LifeStream

LifeStream covered peripheral stent at the transition of the Dacron graft and the LMA ostium (A) and TIMI flow grade 3 without any complication (B). Abbreviation as in [Figure 2](#).



DISCUSSION

Multiple methods exist for reimplanting coronary arteries into the aortic root graft during aortic root surgeries. Bentall and De Bono¹ introduced the technique of directly anastomosing the coronary arteries to the aortic root graft in 1968. In 1981, Cabrol et al² described a method known as the Cabrol procedure, which involves connecting the coronary arteries to a graft shaped like a mustache. This graft is attached side-to-end to the aortic root graft and end-to-end to the coronary arteries (Figure 1). This approach later became known as the classic Cabrol technique, with subsequent modifications being introduced.³ Cabrol modifications include 2 different grafts from both coronary ostia to composite aortic root graft, a graft between aortic root and RCA ostium, and an extra graft anastomosed between the LMA and extra graft between the RCA and aortic root graft. In our case, a Cabrol graft was placed between the LMA and the aortic root graft, while the RCA was directly anastomosed to the aortic root graft.

The modified Cabrol technique has inherent limitations, including graft kinking/thrombosis, occlusion of the ostial coronary arteries, dissection leading to graft failure,⁴ and interventionalists should be familiar with the anatomic corrections and the challenges associated with PCI for successful outcomes. Although limited to case reports, PCI of a stenotic Cabrol graft anastomosis can be safe and potentially less invasive than repeated surgical procedures in appropriate candidates.^{4,5} The CTA was performed to determine whether it was a pseudo-stenosis caused by tension or true stenosis and revealed the pathophysiological mechanism as a fibrotic layer in the

anastomosis suture without atherosclerotic plaque, endorsed by the presence of a zero coronary calcium score.

In our case, to deliver a peripheral stent and ensure sufficient contrast to opacify the 10-mm Dacron graft, we used an 8-F guiding catheter via brachial dissection. This approach was chosen due to the length of the iliac-femoral access and the deliverability considerations of the LifeStream stent, as a long sheath may sometimes be required, potentially limiting the transfemoral approach. Regarding catheter selection for engaging Cabrol and modified Cabrol surgeries—where the coronary artery takeoff is often more anterior—catheters with a downward orientation, such as AL1 and multipurpose, are typically preferred.

VISUAL SUMMARY Chronological Overview	
Timeline	Events
1993	Male patient with Marfan syndrome underwent an ascending aorta aneurysm repair, at the age of 19, with the interposition of an aortic Dacron tube and a mechanical aortic valve prosthesis.
25 years later	Cavo-tricuspid isthmus ablation due to recurrent atrial fibrillation/flutter.
3 years later	CTA revealed a pseudoaneurysm at the Dacron tube, with signs of imminent rupture, requiring urgent surgical intervention. The old Dacron tube was replaced by a new mechanical valve Dacron graft and reimplantation of the LMA using the modified hemi-Cabrol technique.
2 years later	Aortic CTA revealed luminal reduction in the ostium of LMA with anastomosis in the Dacron tube associated with a severe ostial luminal reduction in the RCA originating from the tubular prosthesis of the ascending aorta.
2 weeks later	PCI of RCA anastomosis was performed using trans-radial access and a 6-Fr multipurpose guiding catheter.
6 months later	LMA-Cabrol PCI was performed using brachial access and an AL-1 guiding catheter.
9 months later	Control CTA 9 months after the last procedure revealed no restenosis signs in the stents of the RCA ostium and distal portion of the Cabrol graft. Transthoracic echocardiogram with 59% left ventricular ejection fraction and a normal functioning aortic bioprosthesis.

Given the need for greater support during angioplasty in this specific setting, we opted for the AL1 catheter.

We also used buddy-wire for both LAD and CX to provide greater system support and potentially avoid inadvertent misplacement of the stent to the LAD, compromising CX blood flow. The initial plan included intravascular imaging; however, the ultrasound catheter for peripheral vessel angioplasty was unavailable at the time of the procedure. Consequently, procedural planning relied on angiography and CTA. Undersized stenting of large coronary arteries carries the risk of stent restenosis and stent thrombosis. Generally, sizeable coronary angioplasty balloons and stents are unavailable, and PCI for large coronaries is still challenging. Although such coronary artery stenosis cases could be treated with renal stents in the literature, there is limited data regarding the long-term outcomes and optimal treatment strategies.⁶ In cases of large anastomoses, particularly those with a significant luminal mismatch between the graft and native artery, the use of a covered stent can help mitigate the risk of vessel rupture—a potentially catastrophic complication in these patients. For this case, the LifeStream balloon-expandable covered stent was specifically chosen due to its unique properties that address the complexities of left main stenosis. Its covered design safeguards against vessel rupture, a critical concern in high-risk anatomies. Its high radial strength also ensures robust scaffolding, offering superior support to maintain vessel patency. The balloon-expandable mechanism allows for precise deployment, which is crucial for optimizing fit and positioning in left main lesions, where accuracy is paramount for successful treatment.

FOLLOW-UP

The patient had excellent outcomes and, at 12-month follow-up, was asymptomatic. A control CTA 9 months after the last procedure revealed no restenosis signs in the stents of the RCA ostium and the

Cabrol graft distal portion (Figure 5). Despite the absence of coronary calcification (CTA calcium score 0), ongoing follow-up remains crucial for these patients. Factors such as local inflammation, mechanical stress at the suture site, and healing dynamics may contribute to restenosis. Regular monitoring allows for the early detection and management of potential complications, ensuring optimal long-term outcomes. Likewise, a control echocardiogram revealed normal left ventricular ejection fraction (59%) and a normal functioning aortic bioprosthesis.

CONCLUSIONS

In summary, although the Cabrol procedure is less common than the Bentall procedure, it is highly valuable for selected patients. The Cabrol graft is typically anastomosed anteriorly to the aortic root graft near the corresponding coronary ostium. Cannulating this graft is similar to working with saphenous grafts, and aortography can benefit proper catheter selection. The development of stenosis at the anastomosis site of the Dacron with LMA is potentially catastrophic, and, according to a few previous case reports, PCI may be feasible in selected patients. In cases with huge, interposed tubes and luminal mismatches, peripheral-covered stents might be an essential bailout technique to avoid catastrophic complications. Although PCI cases can be safely performed, as in our case with favorable outcomes, further large-scale case series are warranted with longer-term follow-up.

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KEY WORDS graft anastomotic stenosis, high-risk coronary intervention, left main artery stenosis, modified hemi-Cabrol graft, peripheral covered stent

APPENDIX For a supplemental video, please see the online version of this paper.