

Peripheral bare-metal stent implantation for a very-late stenosis of an aortic-left main Cabrol graft: a case report

Arcangelo Carrera¹, Francesco Contorni ^{1*}, Andrea Gambacciani², and Eugenio Neri²

¹Division of Cardiology, Department of Medical Biotechnologies, Azienda Ospedaliera Universitaria Senese, Siena 53100, Italy; and ²Division of Cardio-Thoracic Surgery, Department of Medical Biotechnologies, Azienda Ospedaliera Universitaria Senese, Siena, Italy

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Background

The surgical ascending aorta repair according to the Cabrol procedure involves the interposition of a prosthetic conduit between the aortic prosthesis and the native coronary ostia. Previous cases of the Cabrol conduit stenosis have been described, most of which presented as acute coronary syndromes due to thrombotic occlusion of the graft.

Case summary

We present a case of stable exertional angina due to very-late stenosis of the coronary prosthetic conduit, successfully treated with trans-femoral percutaneous angioplasty and off-label implantation of a balloon-expandable bare-metal stent designed for peripheral artery disease. The multimodality imaging approach gave an essential contribution both to the assessment of the lesion and to the procedural planning. Despite the concerns about long-term results, a peripheral bare-metal stent was preferred over a standard coronary drug-eluting stent due to the remarkable dimension of the Cabrol conduit. Three years after the procedure, the patient is free from angina, and coronary computed tomography showed no significant luminal loss of the stent.

Conclusion

Elective angioplasty of a Cabrol graft requires a careful planning through a multimodality stenosis assessment. Conventional coronary stents can be not large enough to ensure adequate apposition to the wide prosthetic conduit and peripheral bare-metal stents may be taken into consideration, at the price of unknown long-term outcomes.

Keywords

Case report • Cabrol technique • Bentall technique • Cabrol graft PCI • Multimodality coronary imaging assessment

ESC Curriculum

3.1 Coronary artery disease • 3.3 Chronic coronary syndrome • 3.4 Coronary angiography • 7.5 Cardiac surgery • 9.1 Aortic disease

Learning points

- Surgical re-implantation of the coronary arteries according to the Cabrol technique is rare but still performed and percutaneous coronary interventions through the aortic-coronary graft is feasible.
- A multimodality imaging approach plays a pivotal role to safely guide the interventional procedure through the Cabrol graft.
- Taking into account the large calibre of the Cabrol conduit, a stent designed for peripheral angioplasty could provide a better apposition than a standard coronary drug-eluting stent.

* Corresponding author. Tel: +39 3488246591, Email: francescocontorni01@gmail.com

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Introduction

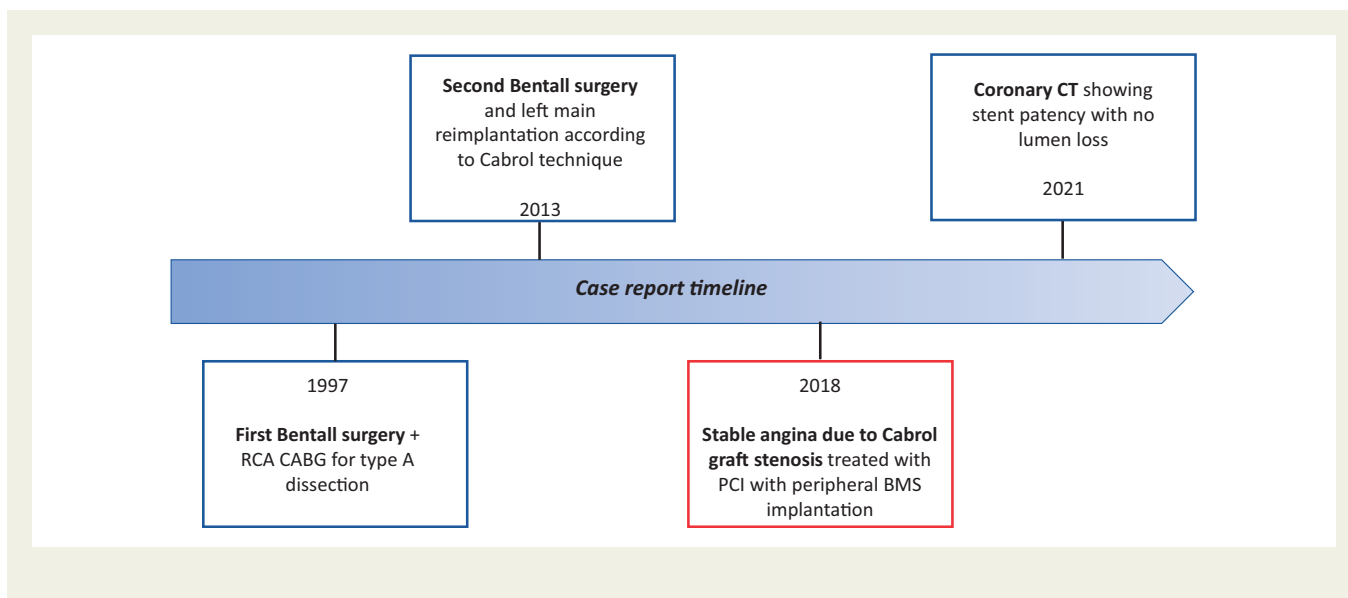
Re-implantation of the coronary arteries on the aortic conduit during surgical ascending aorta repair can be performed according to two main techniques. To date, the modified Bentall procedure (also known as ‘button-Bentall’) is the preferred one: it involves the re-implantation of the coronary vessels to the prosthetic conduit with the interposition of small buttons of the full-thickness aortic wall (obtained from the native aortic sinus and aimed to reduce the bleeding risk).¹ The Cabrol technique is the alternative approach: even if several versions have been described, it generally requires the interposition of a graft between the aortic conduit and the coronary vessels.² This latter technique has been found to be inferior to the Bentall at short- and long-term follow-up;³ nevertheless, it remains a valuable option in the case of high-tension coronary-aortic anastomosis or friable coronary ostia tissue. Therefore, in the setting of repeated ascending aorta surgeries, low coronary origins, and severe calcified aorta, the Cabrol procedure is still performed.

Acute thrombotic occlusion of the Dacron aortic-coronary graft is a known possible short- and long-term complication of the Cabrol technique and several cases have been already reported.⁴⁻⁹ In our article, we describe a case of exertional angina due to the very-late stenosis of the anastomosis between the prosthetic conduit and the left main stem, successfully treated with a percutaneous angioplasty.

Timeline

Case report

A 78-year-old male was referred to our Cardiology Unit due to the recent onset of exertional angina. Twenty-four years before he had undergone urgent Bentall surgery and aortic-right coronary artery bypass for type A dissection with right coronary involvement. After 16 years, he had re-intervention for pseudo-aneurysm formation at the distal anastomosis between the prosthetic aortic conduit and the native aortic arch. During this latter surgery, in order to avoid a second high-risk mobilization of the left main (strictly attached to the myocardium by the adhesions due to the first operation), the left coronary ostium was attached to the aortic conduit according to the Cabrol technique. He had recently performed an aortic computed tomography (CT) scan according to the follow-up program of our Institution that showed a narrowing of the left main-Dacron anastomosis (*Figure 1*). His daily medical therapy included Cardioaspirin, Valsartan, Metoprolol, Atorvastatin, Insulin, and Ranolazine, this last one was recently added on an outpatient basis after the angina appearance, providing only mild symptoms improvement. At the admission, transthoracic echocardiography showed preserved left ventricular ejection fraction, and electrocardiogram (ECG) was normal. He underwent coronary angiography that revealed a discrete hazy lesion at the site of the anastomosis (*Video 1, Figure 2A and B*). Functional evaluation of the stenosis with adenosine-fractional flow reserve (FFR) was performed, obtaining a positive 0.78 FFR value (*Figure 2C*). An intravascular ultrasound (IVUS, Opticross, Boston Scientific) exam was done and, even if the quality of the images was



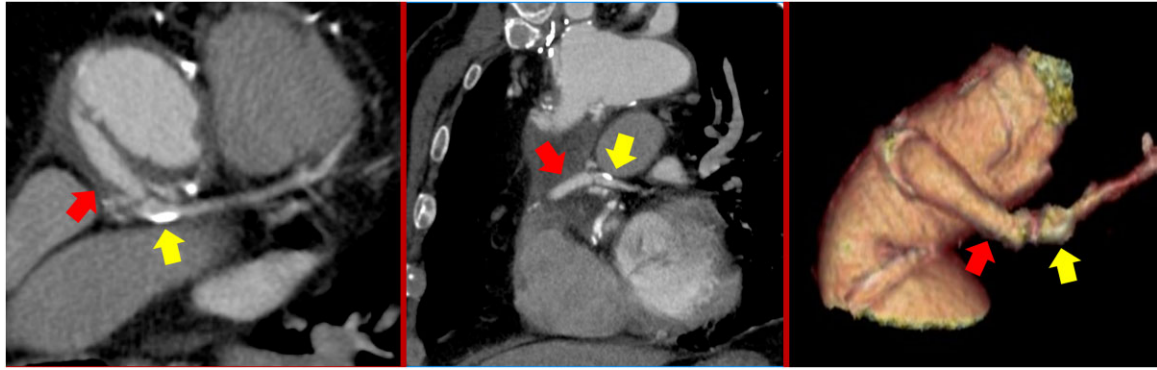
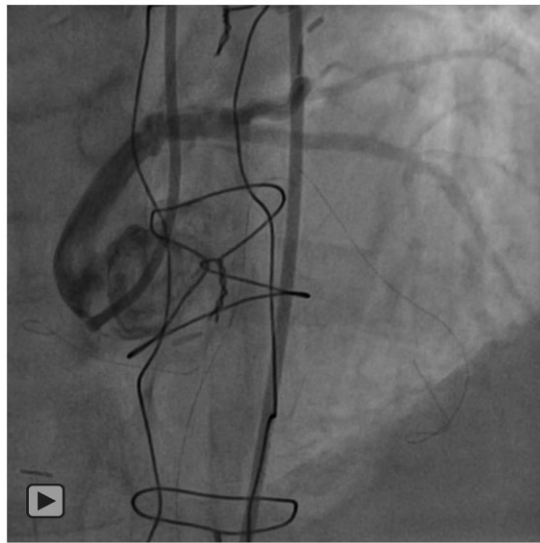
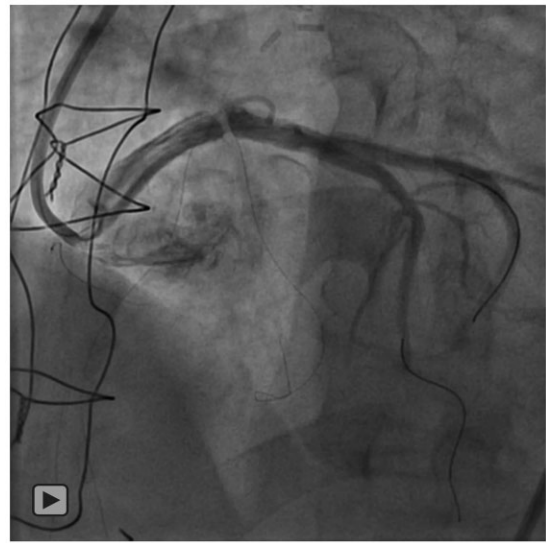


Figure 1 A detail of the aortic computed tomography-angiography exam performed according to the Institutional follow-up program after ascending aortic repair. Even if the quality of the images is suboptimal to allow a reliable coronary evaluation (computed tomography scan was not electrocardiogram-gated), a discrete narrowing at the transition point between the Cabrol graft conduit (red arrow) and the left main stem (yellow arrow) is clearly displayed.



Video 1 Invasive coronary angiography clearly depicting a discrete narrowing at the Cabrol conduit - left main anastomosis.



Video 2 Percutaneous coronary intervention for the Cabrol graft stenosis: pre-dilatation followed by peripheral bare metal stent deployment and final post-dilatation.

limited by the remarkable diameter of the graft, an abrupt narrowing of the Dacron conduit was spotted proximally to the transition point between the graft and the left main (*Figure 2D*). The case was discussed by the Heart Team specialists of our Institution: taking into account the location of the lesion and his functional severity assessed by FFR, revascularization was considered mandatory; although the estimated operative risk was not prohibitive (STS score 2.1%), the percutaneous approach was the preferred strategy mainly due to the technical issues related to a third mobilization of the left main, already surrounded by fibrous adhesions during the previous operation. Angioplasty was performed via trans-femoral approach with an 8-Fr Multipurpose guiding catheter. Both the left anterior descending and

the circumflex artery was wired with two supporting guidewires to stabilize the guiding catheter and facilitate the delivery of the devices. Predilatation with a 5.0 mm × 15 mm semi-compliant balloon was performed. Finally, a 6.5 mm × 12 mm bare-metal stent designed for renal artery angioplasty (RX Herculink Elite, Abbott Cardiovascular) was deployed at nominal pressure (11 atm), covering the transition point between the graft and the left main. The stent balloon was pulled back a few millimetres and post-dilatated at 17 atm, inside the Dacron conduit (*Video 2*).

Final angiography showed the restoration of the vessel patency (*Figure 3A*). Post-procedural IVUS scan confirmed successful stent expansion and, despite the sub-optimal conduit borders visualization,

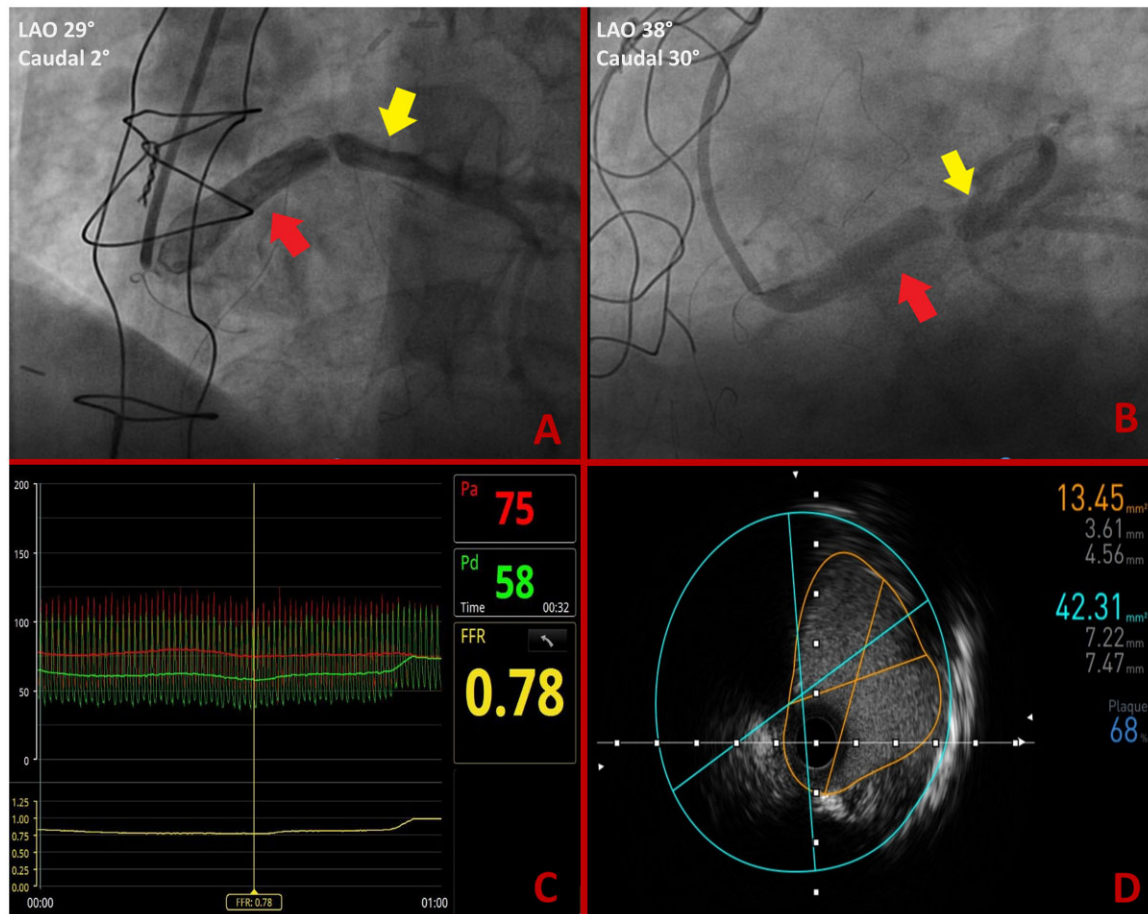


Figure 2 Cath-lab assessment of the Cabrol conduit stenosis. The red arrow shows the prosthetic conduit; the yellow arrow shows the native left main stem. (A, B) Invasive coronary angiography showing a hazy image between the Cabrol conduit and the left main. (C) Functional assessment with fractional flow reserve. (D) Intravascular ultrasound scan, at the site of the conduit narrowing; quality of the intravascular imaging is suboptimal, principally due to the considerable graft diameter.

the stent struts seemed to be adequately opposed to the Cabrol graft (Figure 3B). The patient was discharged the day after the procedure; dual antiplatelet therapy (Cardioaspirin and Clopidogrel) was continued for 1 year; thereafter only Cardioaspirin, on top of life-long standard medical therapy was taken. To date, 3 years after the procedure, he has not suffered with angina anymore. Recently, he underwent a scheduled aortic CT-angiography according to the Hospital imaging follow-up program for previous ascending aorta repair interventions; considering the complex coronary history of the patient it was decided to acquire an ECG-gated angiography in order to adequately assess the coronary patency and, finally, the exam showed no luminal loss of the implanted stent (Figure 3C–E).

Discussion

We reported the case of a successful percutaneous treatment for exertional angina due to very-late stenosis of the Cabrol graft

anastomosis. Percutaneous angioplasty of the Cabrol graft was previously described to be feasible and safe.^{4–9} Nevertheless, some major issues have to be faced. First of all, the graft ostium engagement can be challenging, due to the distorted aortic root anatomy; at the same time, the guiding catheter needs to provide strong back-up support, considering the tortuous course of the Dacron conduit. In our case, the tortuosity of the brachio-cephalic artery made the trans-radial approach challenging, as experienced during the first coronary angiography. Although a left trans-radial catheterization could have been attempted, having to deal with an uncommon and tricky lesion of the left main we felt confident to perform a trans-femoral intervention. Several guiding catheters were attempted before wiring and, in our case, the Multipurpose curve provided the most stable engagement. Deep coronary ostia intubation with the related risk of flow obstruction or vessel injuries is a well-known potential drawback for this type of catheter but the large diameter of the Cabrol Graft and a gentle guide manipulation allowed to safely complete the procedure. Finally, considering the large and healthy common femoral artery

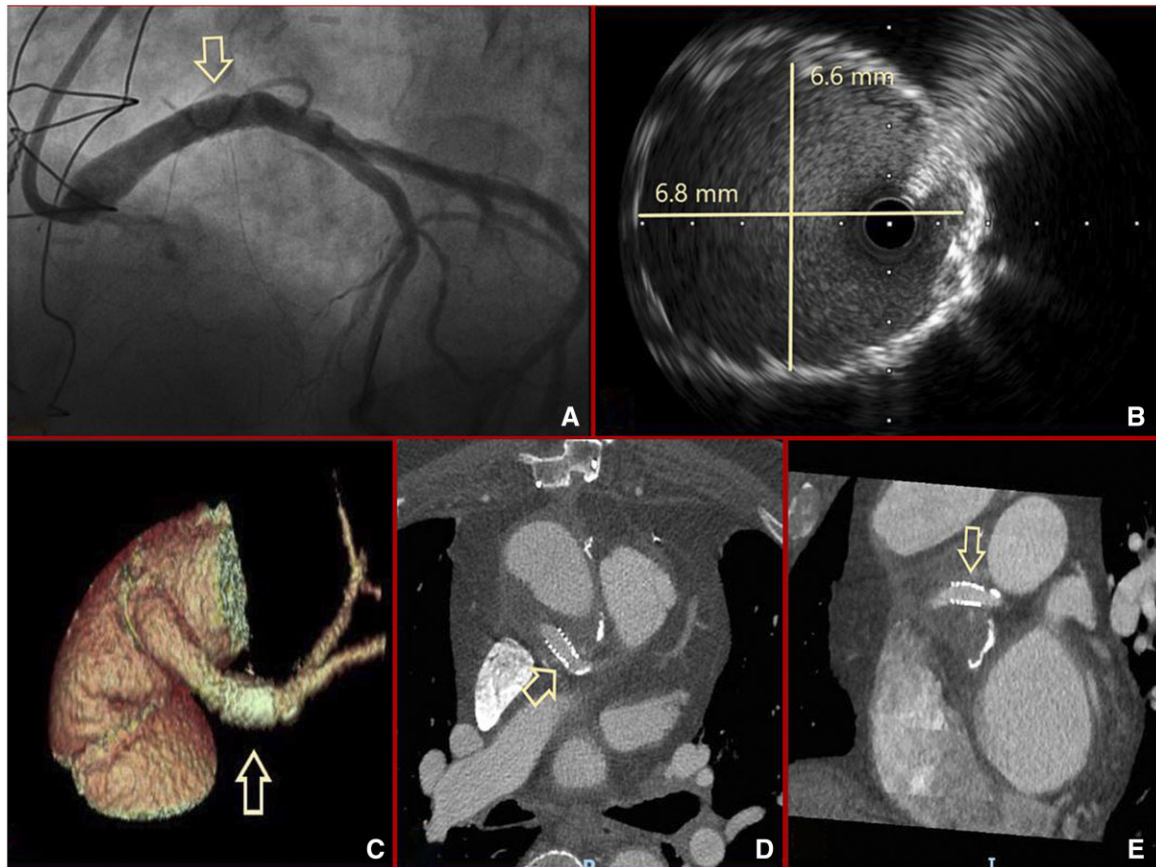


Figure 3 Multimodality imaging assessment of the Cabrol conduit stenosis after percutaneous angioplasty. The arrow shows the implanted bare-metal stent. (A) Left anterior oblique angiographic projection at the end of the procedure shows the patency of the graft and the intended proximal-distal tapering of the implanted stent. (B) Intravascular ultrasound image of the distal Cabrol conduit shows restoration of vessel patency and good stent expansion; even if the conduit borders cannot be sharply displayed, a satisfactory stent apposition seems to be obtained. (C–E) Electrocardiogram gated computed tomography-angiography performed 3 years after percutaneous angioplasty: BMS does not show significant luminal loss.

displayed by the intraprocedural groin ultrasound, we chose an 8 Fr catheter to both improve guide support and to be ready to manage eventual complications, difficult to predict in a similar uncommon scenario. Nevertheless, a 6 Fr catheter would have been large enough to complete the angioplasty and a 7 Fr one could have allowed to face any major procedural issues.

Picking the right stent size was another challenging step of the procedure. The Cabrol graft is usually large (about 6–8 mm diameter) and often there is some grade of dimension mismatch with the left main stem. Even if similar cases treated with standard coronary drug-eluting stents (DES) have been reported,^{4,6,8,9} in our case the 6 mm maximum diameter achievable with the available DES was not enough to guarantee an adequate apposition to the graft and the left main. Off-label coronary implantation of peripheral bare metal stents (BMS) has been demonstrated to be feasible,¹⁰ even if doubts remain about long-term patency. Nevertheless, in a patient at high-operative risk, the choice of a BMS with an adequate diameter over a DES likely to be under-dimensioned seemed reasonable, even paying the price of unknown long-term outcomes. In our case, the three years follow-

up gave satisfactory results. In this regard, we observe that coronary CT scan provided us good and reliable images of the large implanted BMS at follow-up. The multimodality imaging assessment of the target lesion played an essential role to guide the procedure, especially helping to define the length and the diameter of the stent to deploy. At the same time, it is to be observed that despite both intravascular imaging and CT scan was performed, the quality of the images was suboptimal: the low IVUS definition could be explained by the significant conduit diameter while pre-interventional CT scan resolution was limited by the lack of ECG-gating. Given these limitations, the nature of the lesion could not be clearly assessed, although the absence of IVUS images consistent with atherosclerotic disease or thrombosis made the kinking of the conduit the most likely aetiology. However, in the cases of ascending aortic surgery with re-implantation of the coronary arteries, a post-operative imaging follow-up performed with ECG-gated CT-angiography could provide the most reliable assessment of possible coronary lesions.

Finally, this is the first case of adenosine-FFR application to assess the severity of a Cabrol graft lesion. Although FFR is not validated in a

similar setting, there are no haemodynamic reasons to not rely on the diagnostic accuracy of the technique. In fact, the graft narrowing was located extremely close to the left main anastomosis, and it can be functionally interpreted as an ostial left coronary artery lesion. A mild stenosis (<50%, *Video 1*) at the intermediate tract of the left anterior descending artery could have affected the FFR evaluation of the target lesion, but recording a positive 0.78 value with the pressure wire's transducer located just distally to the Cabrol graft anastomosis dispelled any doubts about the severity of the left main stenosis. As in conventional ostial lesions assessment, the guide catheter should be disengaged from the ostium during the pressures recording and, for this reason, intravenous adenosine infusion should be preferred to intracoronary administration.

Conclusions

Re-implantation of the coronary ostia according to the Cabrol technique is rare, but occlusive lesion of the aortic-left main prosthetic conduit can occur and percutaneous angioplasty across the graft is feasible. In the case of chronic coronary syndrome due to the stenosis of the conduit, a multimodality imaging evaluation of the lesion is essential to safely guide the procedure. When stenting of the graft is deemed necessary, the peripheral bare-metal stent can be an option to deal with the remarkable diameter of the prosthesis.

Lead author biography



Arcangelo Carrera is an interventional cardiologist at Siena University Hospital (Italy), a tertiary referral centre for coronary and structural percutaneous interventions. He completed his cardiology training in 2000 and dedicated himself mainly to complex percutaneous coronary interventions and transcatheter aortic valve replacement. During his career, he developed specific interest in multimodality coronary imaging assessment (endovascular imaging and coronary CT).

Supplementary material

[Supplementary material](#) is available at *European Heart Journal - Case Reports* online.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as [Supplementary data](#).

Consent: The authors confirm that written consent for submission and publication of this case report including images and associated text has been obtained from the patient in line with COPE guidance.

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Conflict of interest: None declared.

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