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CASE REPORT
Coronary heart disease

Zero-contrast percutaneous coronary intervention for chronic total occlusions guided by intravascular ultrasound with ChromaFlo mode: a case report

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Background Contrast agent allergy may result in severe adverse events that prevent the use of percutaneous coronary intervention (PCI) in some patients, especially for those with complex lesions.

Case summary We describe a 59-year-old man who presented with the multi-vessel disease and suffered from contrast allergy. The patient refused to have coronary artery bypass grafting surgery, thus two-stage PCI procedures without iodinated contrast media were performed after a detailed discussion with the heart team, including a chronic total occlusion (CTO) lesion in the proximal left anterior descending artery. The intravascular ultrasound (IVUS) was used for finding the entry point of the proximal fibre cap, and assessing the lesion, thereby marking the positions of the proximal and distal edges of the stent. After PCI, stent expansion and subtle edge dissection or incomplete apposition were confirmed by IVUS and ChromaFlo imaging. Zero-contrast PCI was done successfully without any complication.

Discussion This case report illustrates the feasibility and safety of performing CTO-PCI without contrast agent in carefully and well prepared selected patients.

Keywords Case report • Percutaneous coronary intervention • Chronic total occlusions • Contrast allergy • Intravascular ultrasound

Learning points

- It provides a new option for patients with contrast allergy who need to perform percutaneous coronary intervention (PCI), even for chronic total occlusion lesion.
- The procedure utilizes the previous angiogram as a road map combines with intravascular ultrasound imaging for navigating the guidewire and confirming the size and location of the stent.
- The ChromaFlo mode, which is based on Doppler shift principles, is a useful tool to detect subtle distal edge dissection, minor malposition, thrombus and even blood flow during PCI.

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Introduction

Contrast media is generally considered as an indispensable part of percutaneous coronary intervention (PCI), allowing the physicians to visualize the vessel lumen. However, certain patients exhibit some adverse effects such as contrast nephropathy and allergic reactions when exposed to contrast media.[1,2] Although the use of intravascular ultrasound (IVUS)-guided PCI significantly reduces contrast volume and the occurrence of contrast-induced acute kidney injury,[3] limited progress has been made in chronic total occlusion (CTO) lesions. In this report, we describe a case of zero-contrast CTO-PCI with IVUS guidance for a patient with an allergic reaction to contrast media.

Timeline

Time	Events
29 November 2018	Patient presented to our hospital due to repeated episodes of chest pain.
01 December 2018	Diagnostic coronary angiography performed, which showed 99% stenosis with TIMI 1–2 flow in the proximal right coronary artery (RCA) and a chronic total occlusion (CTO) in the proximal left anterior descending (LAD) artery.
01 December 2018	Patient developed a rash and itching of his face and chest with erythematous multiform, and diagnosed as contrast agent allergy.
07 December 2018	The patient underwent percutaneous coronary intervention (PCI) to the culprit lesion in the RCA at the first stage.
14 January 2019	We perform LAD PCI for CTO with zero-contrast guide by intravascular ultrasound.
2019	The patient was followed-up, and no further events were reported.

Case presentation

A 59-year-old man with a background of hypertension presented to our hospital due to repeated episodes of chest pain. He had a history of allergy to cephalosporin. The physical examination revealed the following: blood pressure, 118/75 mmHg; and heart rate, 97 b.p.m. There was no cardiac murmur and pulmonary rales. The electrocardiogram (ECG) displayed ST-segment depression in lead II, II, aVF and abnormal Q-waves in the anterior wall. The blood test showed elevated cardiac enzyme (troponin I 1.066 ng/mL, normal value <0.15 ng/mL). A presumptive diagnosis of non-ST-segment elevation myocardial infarction was made based on an elevated troponin level combined with the ECG changes. Echocardiography revealed normal size of each chambers with ejection fraction of 50% and anterior wall motion hypokinesis. According to high risk with GRACE score >140, an angiogram was performed immediately using 20 mL of iodixanol (GE Healthcare) showing a 99% stenosis with TIMI 1–2 flow in the proximal right coronary artery (RCA) and a CTO lesion in the proximal left anterior descending (LAD) artery (*Figure 1*). The SYNTAX score was 23.5, and J-CTO score was 1 according to blunt stump type. Immediately after angiography, the patient developed irritating rashes on his face and chest which we diagnosed as erythematous multiform. When administrated with desloratadine citrate disodium (8.8 mg) and chlorpheniramine, the patient's skin condition gradually subsided. The cardiac surgery thought it is not very appropriate to perform cardiac surgery in the acute stage of myocardial infarction, and the patient also refused coronary artery bypass grafting, two-staged PCI procedures without iodinated contrast media were scheduled and performed after detailed discussion with the heart team.

Initially, the patient underwent PCI for the culprit lesion in the RCA, although no viability or ischaemia test was performed previously. Prophylactic corticosteroid was administered just for emergencies. A 6-Fr JL 3.5 guiding catheter (Terumo, Japan) inserted into the RCA. With the previous angiogram as a road map, two guidewires inserted into RCA (VERSATURN, Abbott) and acute marginal branch (SION blue, Asahi). The IVUS catheter (Volcano, CA) was advanced to the RCA and manual pullback imaging was performed (*Figure 2*). According to the IVUS result, a 4.0*33 mm drug-eluting stent was implanted after sufficient pre-dilatation. IVUS was repeated and showed full stent expansion without edge dissection confirmed by the IVUS ChromaFlo function (Volcano, CA, USA) (*Figure 3*). We observed no change in vital symptoms and ECG, and there was no pericardial effusion on the echocardiography performed immediately after PCI. The patient was discharged 5 days after PCI without any complications. Optimal medical treatment including dual antiplatelet therapy, statin, beta blocker, and angiotensin-converting enzyme inhibitors were administrated.

The patient was admitted to our hospital for the second stage operation 1 month later because of repeat angina. We intended to perform CTO-PCI of LAD without contrast and prophylactic corticosteroid was administered as mentioned above. A 7-Fr EBU 3.75 guiding catheter (Medtronic, USA) was inserted into the LAD. Previous angiographic images were uploaded the adjunct monitor to guide coronary wiring (*Figure 4A*). A workhorse wire (Runthrough Extra Floppy, Terumo) was placed in the first diagonal branch (DA) which is adjacent to the proximal cap of the CTO. The IVUS catheter was advanced into the DA to identify the intimal plaque position and demonstrate the 'sweet spot' for wire advancement at the entry of CTO lesion (*Figure 4B*). At first, we used a flexible tip guidewire (Fielder XT-R, ASAHI) in an attempt to track the microchannel but failed. Then, hydrophilic guidewires (Pilot 150, Abbott) were used to penetrate the proximal fibrous cap, and we reinserted the IVUS catheter into the DA to reconfirm that the starting point is correct (*Figure 4C*). We continued to advance the guidewire within the occlusion segment; however, it then apparently entered the subintimal space. Consequently, the 'parallel wire technique' was used by another guidewire (Pilot 200, Abbott) (*Figure 4D*) to successfully reach the distal section of the LAD. We manoeuvred the guidewire to a DA, which confirmed that the wire was in the true lumen (*Figure 4E and F*). Then we exchanged a workhorse to the distal (*Figure 4G*) and IVUS-guided PCI was then performed (*Figure 5*). We adopted a crossover strategy for this bifurcation lesion, however 'Final Kissing' was

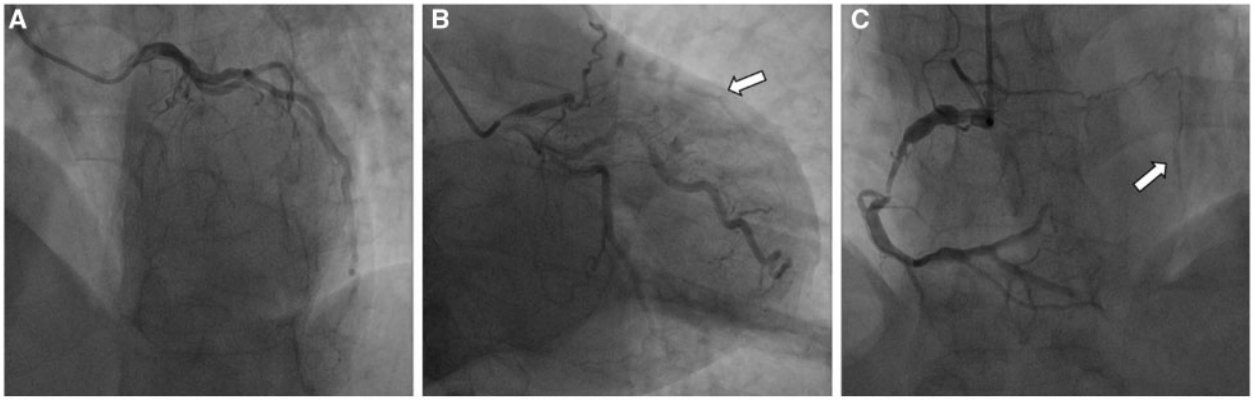

Figure 1 Diagnostic coronary angiography. (*A*) left coronary artery in left anterior oblique and cranial view; (*B*) left coronary artery in caudal view. (*C*) Right coronary artery in cranial view. There was total occlusion in left anterior descending artery with collaterals from left circumflex artery and right coronary artery, and sub-total occlusion in the proximal right coronary artery (*white arrow*).

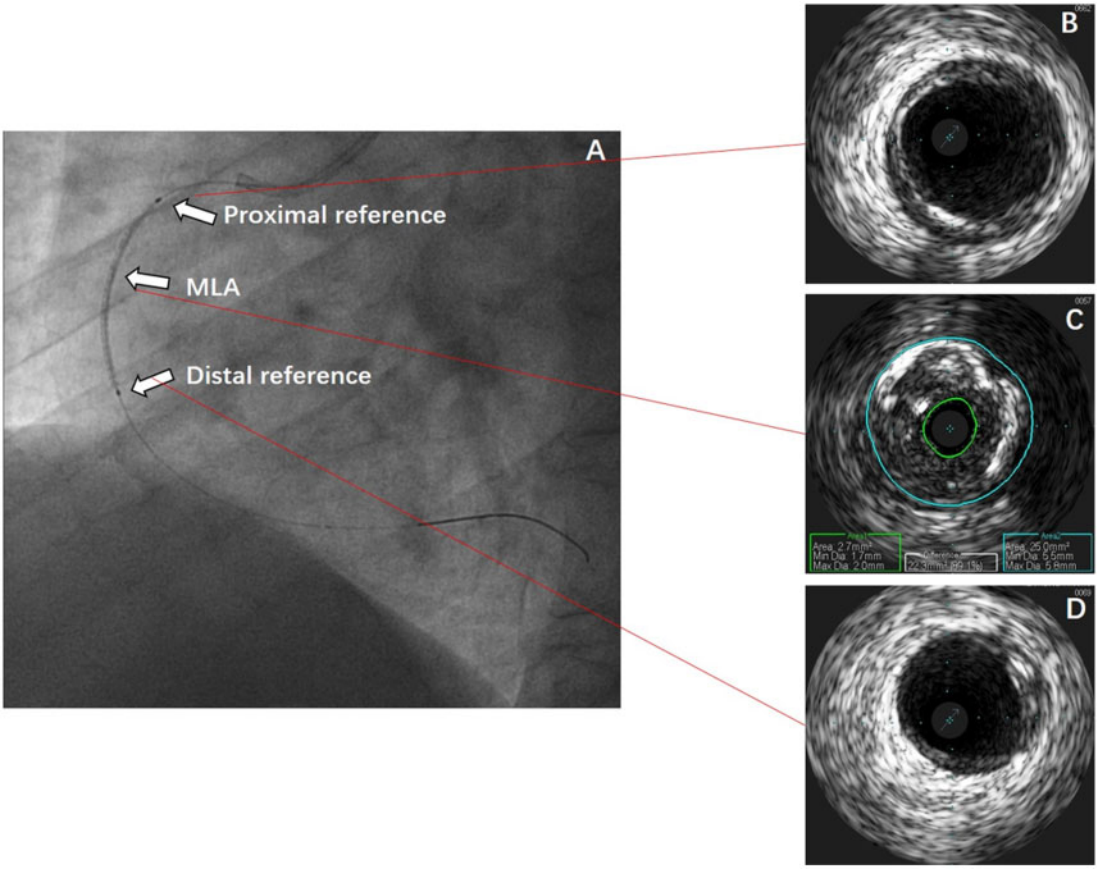

Figure 2 Intravascular ultrasound evaluation before percutaneous coronary intervention. (*A*) Stent positioning guided by intravascular ultrasound. (*B*) Intravascular ultrasound image at the proximal region to indicate proximal landing zone, (*C*) In the middle of the stenosis showing minimal lumen area. (*D*) Distal reference lumen image.

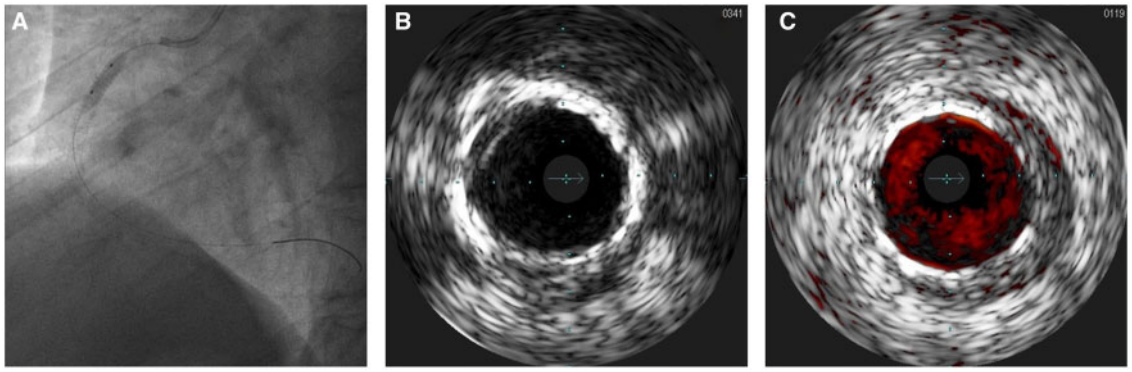

Figure 3 (*A*) Post-dilation with NC balloon. (*B*) In the middle of the stenosis with full dilatation of the stent. (*C*) ChromaFlo model shows that there are no dissections, stent malapposition, and thrombus formation.

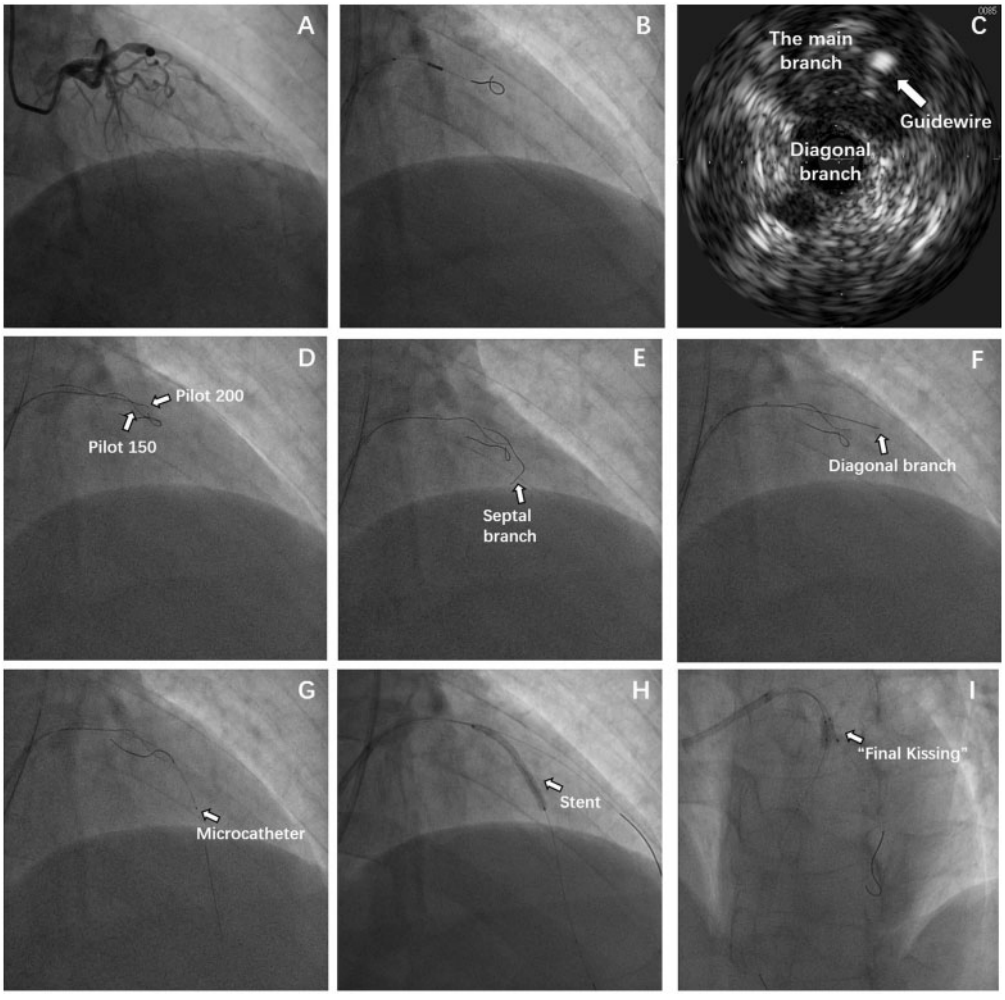

Figure 4 (*A*) Total occlusion in the proximal left anterior descending artery (right anterior oblique and Cranial views). (*B*) Intravascular ultrasound catheter advanced into the diagonal branch, (*C*) to identify the intimal plaque position and locate the optimal stent landing zone. (*D*) 'Parallel-wire technique' was performed. Placing the wire into the septal branch (*E*) and diagonal branch (*F*), to confirm the true lumen. Using Finecross for exchange the worked wire (*G*) and then implanting the stent with the intravascular ultrasound guidance (*H*). 'Final Kissing' technique with MAVERICK 2.0*15 mm balloon was applied to address the bifurcation lesion (*I*).

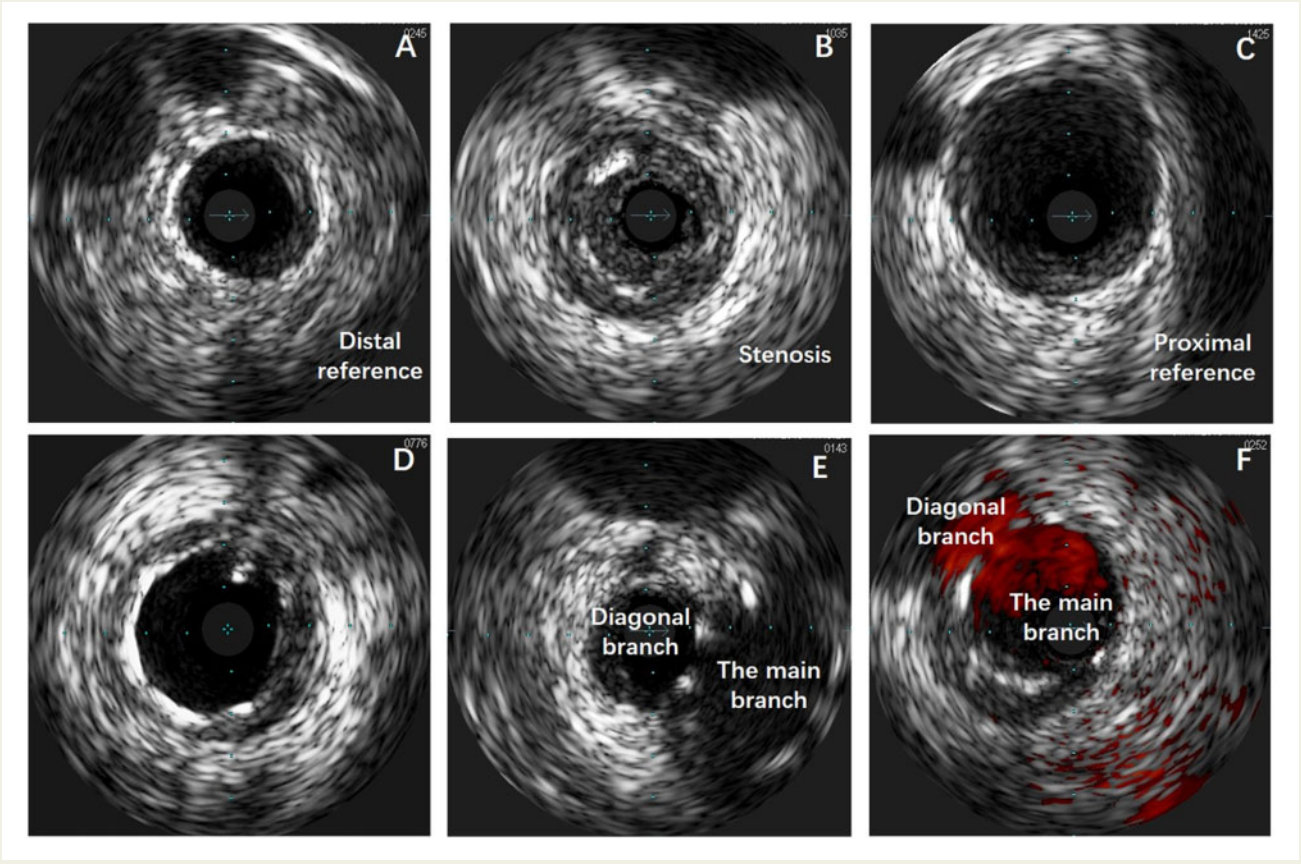

Figure 5 Performed intravascular ultrasound catheter pullback and measured the distal reference (*A*), minimal lumen area (*B*), and proximal reference lumen (*C*). Intravascular ultrasound images post-stenting show adequate stent expansion without any dissection (*D* and *E*). The ChromaFlo mode demonstrates the blood flow in the side branch (red colour) (*F*).

applied to protect the side branch (*Figure 4H* and *I*). Echocardiography was performed immediately after PCI to rule out wire-related perforation. The patient was discharged 2 days after the operation, followed-up in outpatient for 1 year and experienced significant improvement in their chest pain symptoms without need for hospitalization.

Discussion

Zero or minimum contrast PCI by IVUS guidance has been reported to be relatively safe and feasible for patients with chronic kidney disease.[4] However, its applications in complex cases such as CTOs is still not well documented. In this case report, we describe a 59-year-old man exhibiting sensitivity to contrast media undergoing PCI twice to address complex lesions guided by IVUS and Chromaflo imaging without the use of contrast.

PCI for CTO can be challenging and often leads to high-dose contrast agent utilization.[5] According to our case, zero-contrast PCI for CTO lesion is also feasible with IVUS guidance; however, significant operator experience is required. First of all, the diagnostic angiogram is fundamental for navigating the guidewire through occlusion lesion without contrast. In addition, the diaphragm, bony landmarks, heart shadow, and others can also serve as important markers for indication. Secondly, IVUS is also an indispensable tool which can identify the features of proximal fibre cap to assist in choosing appropriate guidewire, and the 'real-time' IVUS guidance also contribute to finding the entry point. Moreover, manual IVUS pullback combined with a similar angle of the reference image allows for a more accurate selection of the landing zone according to our experience. Furthermore, confirming the guidewire position in the true lumen is a challenge without contrast media. Placing the wire into different branch and observing the blood flow from the microcatheter is an alternative.

Various complications are the leading cause of procedure failure. We utilized the ChromaFlo technology, a modality that visualizes blood flow by interpreting any differences in the position of echogenic blood particles as blood flow, to detect subtle distal edge dissection, minor stent malapposition, thrombus and even explored blood flow including main branch and side branch (represented on the image with red colour).

For patients with anaphylaxis to contrast agent, pre-medications using corticosteroids and H-1 antihistamine drugs are recommend.[6] However, desensitization has long been used for refractory allergic reactions to common allergens. Uppal *et al.*[7] described a case of severe allergic reaction to contrast that was managed with a desensitization therapy successfully. Rapid desensitization could be an

effective strategy for the management of patients with refractory allergy reactions to contrast media.

Conclusion

This case report illustrates the feasibility and safety of performing CTO-PCI without contrast agent in carefully selected patients. It provides a new option for patients who are sensitive to contrast media.

Lead author biography

Chen-Yang Chen was born in Hunan, China, in 1989. He received the MD degree from Xiangya School of Medicine, Central South University in 2018. Since 2018, he began to work and receive interventional cardiology training at the Third Xiangya Hospital of Central South University. His research interest is mainly focused on cardiac interventional therapy, fractional flow reserve, and ischaemic heart diseases.

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 author/s confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidance.

Conflict of interest: none declared.

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