ESC European Society of Cardiology

European Heart Journal - Case Reports (2023) **7**, 1–6
https://doi.org/10.1093/ehjcr/ytad484

CASE REPORT
Coronary intervention

Chronic total occlusion of the left circumflex coronary artery with collateral channels from the bronchial artery: a case report

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Received 6 March 2023; revised 20 September 2023; accepted 2 October 2023; online publish-ahead-of-print 4 October 2023

Background Chronic total occlusion (CTO) lesions contain various collateral channels. Only a few reports have described CTO with collateral channels from the bronchial arteries.

Case summary Herein, we report the case of a 59-year-old man with a left circumflex (LCX) coronary artery CTO with collateral channels from the bronchial arteries. The J-CTO score was 1. After confirming myocardial viability and myocardial ischaemia using a stress myocardial perfusion imaging test, we performed percutaneous coronary intervention for the CTO lesion. Successful revascularization was achieved by adopting the antegrade approach with the angiogram guidance of distal visualization using the bronchial artery.

Discussion Notably, there are no other reports of LCX CTO with collateral channels from the bronchial artery. Distal visualization of the distal true lumen is essential for the success of the antegrade approach. Furthermore, appropriate distal visualization helps to avoid unnecessary retrograde approaches and reduce complications.

Keywords Case report • Percutaneous coronary intervention • Chronic total occlusion • Collateral channel • Bronchial artery

ESC curriculum 3.1 Coronary artery disease • 3.4 Coronary angiography

Learning points

- The bronchial artery is occasionally a collateral channel of the chronic total occlusion of the right coronary artery and the left circumflex coronary artery.
- Distal visualization using the bronchial artery can help avoid unnecessary retrograde approaches. Appropriate distal visualization using the bronchial artery can help simplify the percutaneous coronary intervention procedure.

Introduction

The retrograde approach in percutaneous coronary intervention (PCI) for chronic total occlusion (CTO) is essential for improving technical success.[1,2] However, the antegrade wiring technique must be used when there are no interventional collateral channels, according to the global CTO crossing algorithm.[3] Furthermore, compared with the antegrade approach, the retrograde approach has been recently reported to be associated with unfavourable cardiovascular outcomes in patients who undergo CTO PCI.[4] Therefore, the antegrade approach remains essential for contemporary CTO PCI.

In the antegrade approach, the guidewires occasionally enter the subintimal space, which may result in CTO PCI failure. For successful antegrade wiring, the tip of the guidewire should be directed towards the distal true lumen, making the visualization of the distal true lumen important for increasing the success rate of the antegrade approach.[5]

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Handling Editor: Krishnaraj Rathod
Peer-reviewers: Raheel Ahmed; Alessia Azzano; Ojas H. Mehta
Compliance Editor: Emmanouil Mantzouranis

Herein, we report the case of CTO of the left circumflex (LCX) coronary artery with collateral channels from the bronchial artery in which antegrade PCI with distal visualization using the bronchial artery was performed. Notably, there are no other clinical case reports of LCX CTO lesions with collateral channels from the bronchial artery. In this report, we focus on the presence and importance of collateral channels from the bronchial artery.

Summary figure

November 2021	The coronary artery calcium was incidentally detected on computed tomography (CT) following pulmonary sarcoidosis
April 2022	Coronary angiography was performed, and severe stenosis of the ostial left anterior descending (LAD) coronary artery and chronic total occlusion (CTO) of the proximal left circumflex (LCX) coronary artery were confirmed. Percutaneous coronary intervention (PCI) of the proximal LAD was successfully performed
May 2022	Coronary CT angiography (CCTA) revealed a relatively short occlusion length of the LCX CTO compared with the expected occlusion length observed on angiography
June 2022	A chest CT scan of the aortic arch revealed the collateral channels from the bronchial artery to the LCX CTO
September 2022	The PCI for the LCX CTO was successfully performed

Case presentation

A 59-year-old Asian man was incidentally diagnosed with coronary artery calcification on follow-up CT for pulmonary sarcoidosis. His coronary risk factors were hypertension and dyslipidaemia.

The physical examination demonstrated the following vital signs: blood pressure, 113/66 mmHg and heart rate, 67 b.p.m. Electrocardiography revealed sinus rhythm with mild ST depression in Leads V4–V6. Transthoracic echocardiography revealed normal left ventricular function and no significant valvular heart disease. Blood tests revealed normal renal function.

Because the patient presented with shortness of breath, which was thought to be due to coronary artery disease, coronary angiography (CAG) was performed. Coronary angiography revealed a severe stenosis of the ostial left anterior descending (LAD) coronary artery and a CTO lesion in the proximal LCX (*Figure 1A*). Collateral channels were observed extending from the right coronary artery (RCA) through the posterior descending (PD) branch to distal the LCX (*Figure 1B*). The occlusion length of LCX CTO is expected to be long because the collateral channels from the RCA PD filled only the distal portion of the LCX. Subsequently, PCI was performed on the proximal LAD lesion, and a drug-eluting stent was implanted.

The patient received optimal medical therapy consisting of aspirin 100 mg o.d., prasugrel 3.75 mg o.d., atorvastatin 10 mg o.d., and ezetimibe 10 mg o.d. Stress myocardial perfusion imaging with single-photon emission CT revealed ischaemia in the posterolateral territory of the left ventricle, transient ischaemic dilatation, and left ventricle ejection fraction deterioration (see Supplementary material online, *Figure S1A* and *B*). Therefore, an LCX CTO PCI was planned.

Coronary CT angiography was performed after CAG to determine the procedure strategy for LCX CTO PCI. Coronary CT angiography revealed a shorter occlusion length of the LCX CTO than expected based on the previous CAG (*Figure 2A* and *B*). The estimated CTO length evaluated using CCTA was 4 mm. Chest CT was additionally performed to detect extracardiac collaterals. The chest CT indicated an extracardiac collateral flow from the bronchial artery to the distal portion of the LCX CTO (*Figure 3A* and *B*). This bronchial collateral channel explains the discrepancy in anatomical recognition between CAG and CCTA.

We planned to perform LCX CTO PCI using the antegrade approach because the CTO length was short, and the CTO exit was confirmed using the bronchial artery injection. Furthermore, the retrograde approach through RCA PD channels was considered difficult and had a risk of complications because the collateral channels from the RCA were non-septal and relatively small, with the J-Channel score of 3. The J-CTO score was 1. The procedure was performed using the bilateral femoral approach with an 8 Fr, SPB 3.75 SH, 100 cm guiding catheter (Asahi Intecc Co., Ltd, Aichi, Japan) for the antegrade approach and a 5 Fr diagnostic catheter for retrograde angiography. A bronchial arteriography was also performed. We attempted to engage the catheter in the bronchial artery under the guidance of three-dimensional CT angiography of the aorta (*Figure 3A* and *B*). We failed to engage the catheter in the bronchial artery using both Judkins Right 4.0 and Amplatz Left 1.0 types. However, we succeeded in engaging a 5 Fr, shepherd hook 12, 70 cm (SHK 12) catheter (Hanako Medical, Saitama, Japan) into the bronchial artery (*Figure 4A* and *B*). Bronchial arteriography clearly revealed the CTO distal cap and distal true lumen of the LCX CTO (*Figure 4C* and *D*). Dual injection showed CTO morphology with blunt proximal and tapered distal caps. The CTO lesion was approached using a Gaia-Next 2 (Asahi Intecc) guidewire supported by a SASUKE dual-lumen microcatheter (Asahi Intecc). Gaia-Next 2 could not pass through the CTO proximal cap, and guidewire escalation was performed using Gaia-Next 3 (Asahi Intecc) and Conquest Pro 12 (Asahi Intecc) guidewires. Eventually, the Conquest Pro 12 penetrated the proximal cap. The Conquest Pro 12 was gradually advanced into the body of the CTO lesion, and the wire was passed into the distal true lumen with distal visualization using bronchial arteriography. We then implanted a drug-eluting stent, which resulted in successful revascularization (*Figure 5A* and *B*). The patient was discharged without adverse events. At 6 months post-PCI, the patient had no chest-related complaints.

Discussion

Coronary CTO lesions with collateral channels originating from the bronchial arteries are rare. To date, there have been no clinical case reports of LCX CTO with collateral channels originating from the bronchial artery.

Bronchial arteries have been reported to primarily arise from the thoracic aorta, and origins from the aortic arch are rare.[6] Collateral arterial connections between the coronary and the bronchial arteries are induced on the roof of the left atrium because there is no pericardial covering.[5] Therefore, collateral channels from the bronchial artery may interact with the CTO of the proximal RCA or LCX.[5]

A case series of RCA CTO with collateral channels from the bronchial artery has been previously reported, in which the CTO was successfully revascularized using antegrade wiring under bronchial arteriography.[5]

The right bronchial arteries may develop a common trunk with the intercostal arteries, from which the spinal branches diverge, although the left bronchial arteries do not.[7] Therefore, injury to the right bronchial artery increases the risk of transverse myelopathy. As such, bronchial arteriography should be carefully performed during PCI to avoid

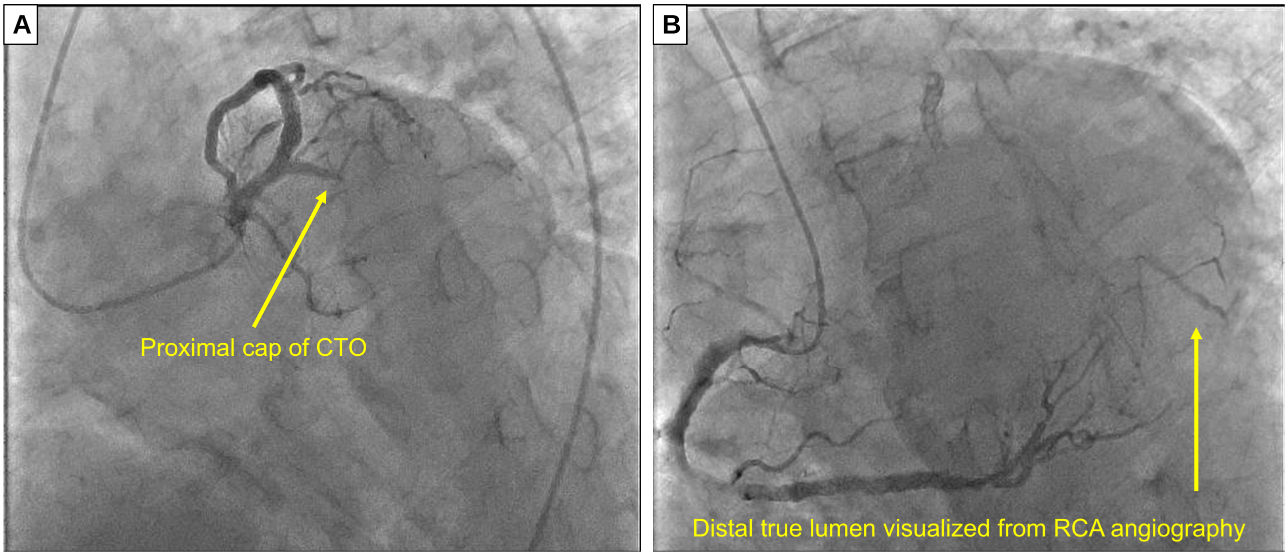


Figure 1 (*A*) Angiographic image of the proximal left circumflex coronary artery before percutaneous coronary intervention. There is a blunt-type proximal cap of chronic total occlusion. (*B*) Left circumflex chronic total occlusion distal cap could not be clearly seen with ipsilateral and contralateral injections.

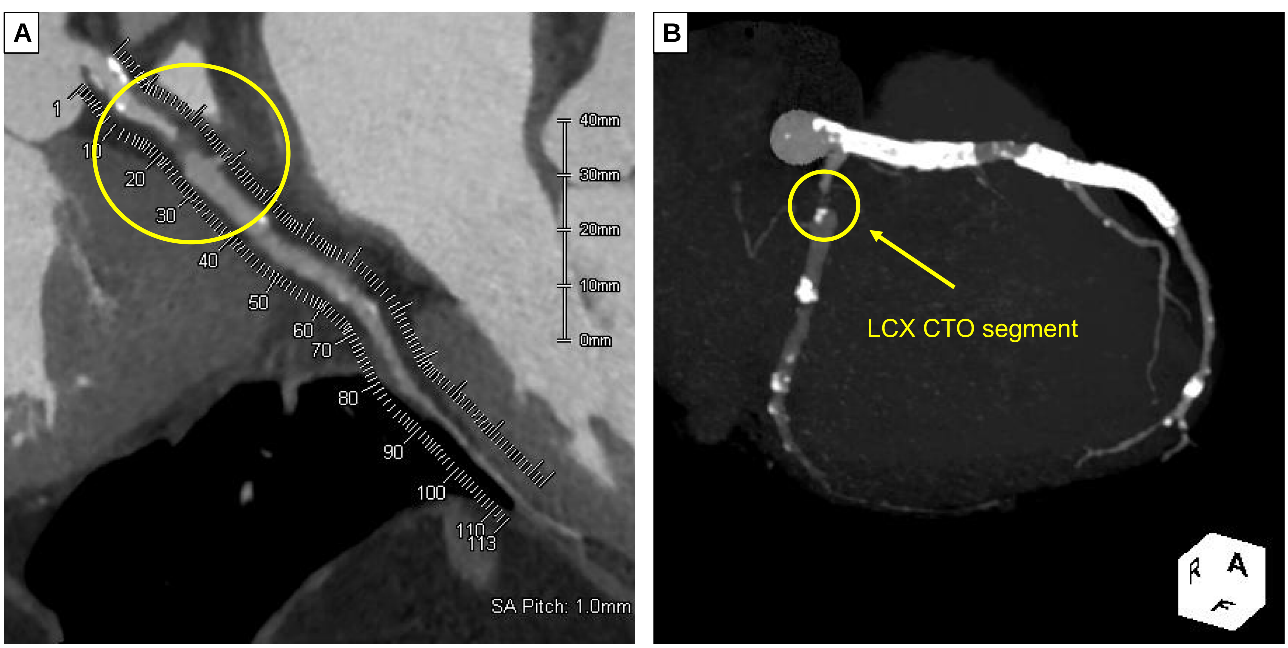


Figure 2 (*A*) Curved planner reconstruction image of pre-procedural coronary computed tomographic angiography shows a short occlusion length of chronic total occlusion of the left circumflex coronary artery. (*B*) Maximal intensity projection image of pre-procedural coronary computed tomographic angiography.

transverse myelopathy. Furthermore, the collateral channels from the bronchial artery in the present case seemed to be composed of small vessels. Therefore, to avoid channel injury or complications, a retrograde approach through the bronchial arteries is not recommended.

In the present case, we successfully revascularized the LCX CTO using an antegrade wiring technique with distal visualization using left bronchial arteriography. Chest CT revealed an extracardiac collateral flow from the bronchial artery to the LCX CTO. Pre-procedural

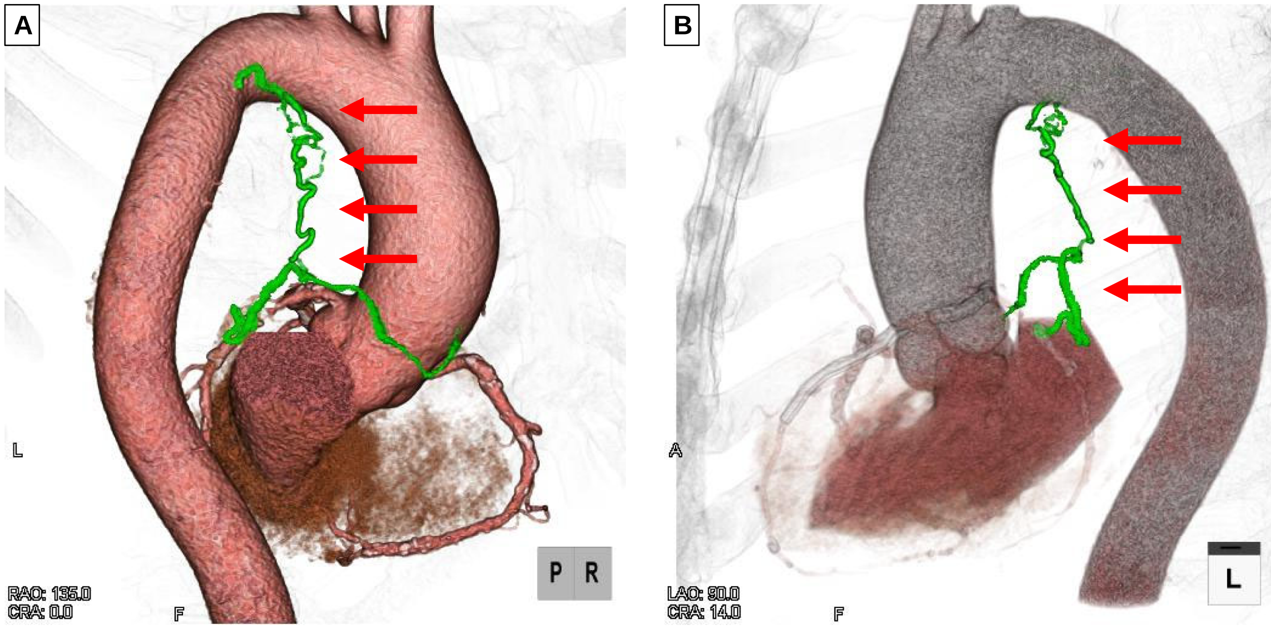


Figure 3 (*A* and *B*) Computed tomography images reveal the connection between bronchial arteries and the left circumflex coronary artery (red arrow).

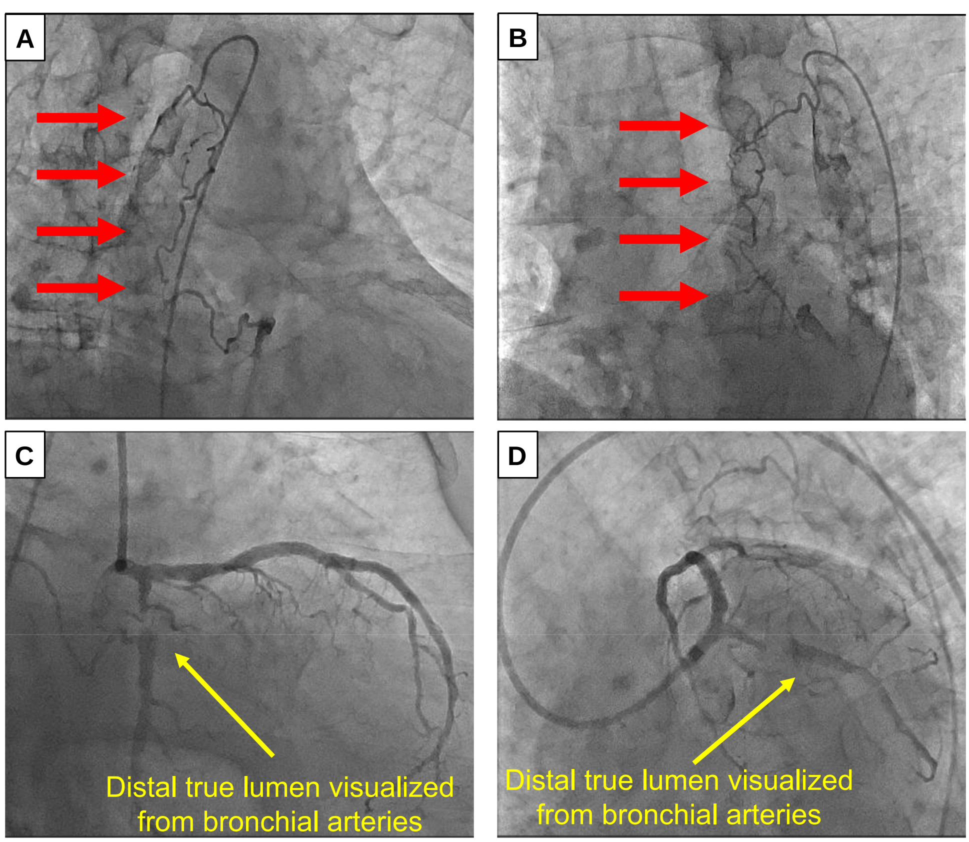


Figure 4 (*A* and *B*) Bronchial arteriographies show the collateral channels to the chronic total occlusion of the left circumflex coronary artery (red arrow). (*C* and *D*) Bronchial arteriography shows the distal cap at the true lumen of the chronic total occlusion of the left circumflex coronary artery.

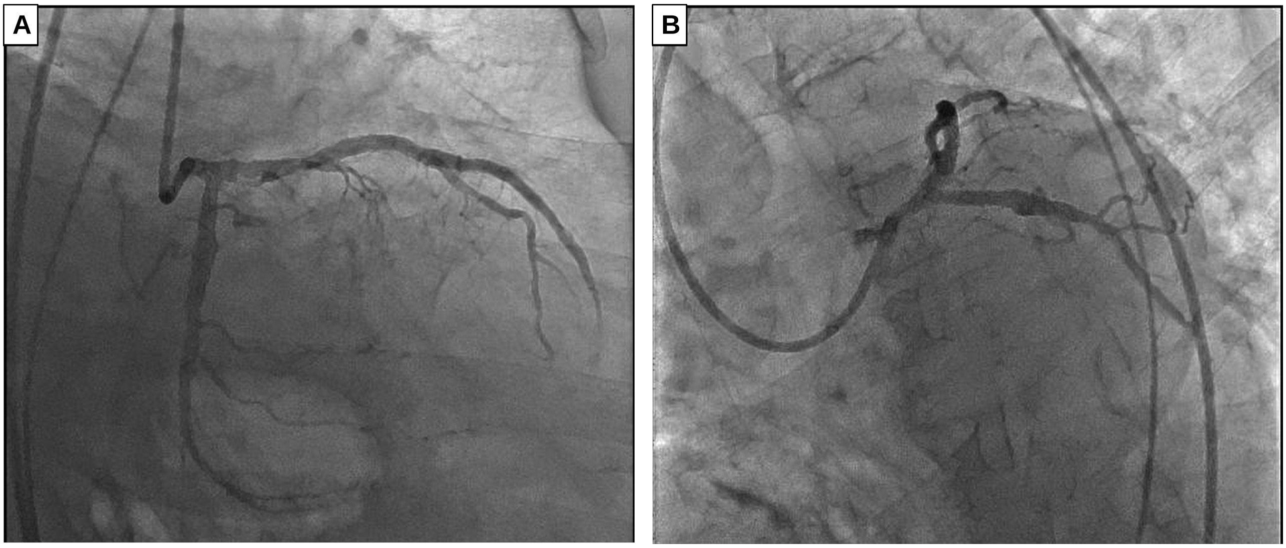


Figure 5 (*A* and *B*) Final angiographic results after percutaneous coronary intervention for the chronic total occlusion of the left circumflex coronary artery.

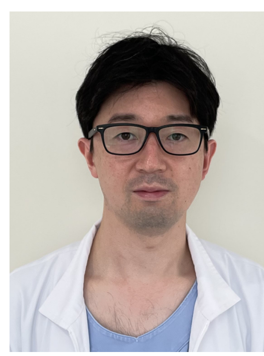
CCTA is recommended in CTO PCI because it can provide important information for CTO PCI, including plaque morphology, coronary calcification, and length.[8] Furthermore, a previous study demonstrated that pre-procedural CCTA is associated with higher success rates of CTO PCI.[9] In proximal RCA or LCX CTO cases, a chest CT scan is recommended to locate extracardiac collaterals if the CTO exit is not clearly visualized using CAG, and there is a discrepancy in anatomical recognition between CAG and CCTA.

In the present case, bronchial arteriography revealed the distal true lumen of the LCX CTO, which was essential for the antegrade success. There are other collateral channels to the LCX CTO from the RCA PD. However, the PD channels are non-septal channels with small diameter vessels. Therefore, a retrograde approach from the PD channels is expected to be difficult based on the J-Channel score and has a risk of complications.[10] In addition, the retrograde approach to CTO PCI has been reported to be associated with a higher rate of major cardiovascular complications; however, it has been an essential technique for the success of CTO PCI.[4] In CTO PCI, it is important not to use unnecessary retrograde approaches to avoid complications. In the present case, the revascularization of the LCX CTO was successfully performed under distal visualization using the bronchial artery without a retrograde approach.

Conclusion

We successfully revascularized an LCX CTO lesion using antegrade wiring with distal visualization using bronchial arteries. Notably, there have been no other case reports of LCX CTO with collateral channels originating from the bronchial arteries. Distal visualization using bronchial arteries may circumvent unnecessary retrograde approaches and enable safe CTO PCI procedures.

Lead author biography



Dr Tetsuya Takahashi was born in Miyagi, Japan, in 1986 and graduated from Yamagata University in 2010. Now, he is a cardiologist at the Japanese Red Cross Ishinomaki Hospital.

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports* online.

Acknowledgements

The authors thank all the staff of the heart team at the Japanese Red Cross Ishinomaki Hospital for their support. The authors also thank Editage (www.editage.jp) for English language editing.

Consent: The authors confirm that written consent for the submission and publication of this case report, including images and associated text, was obtained from the patient according to the COPE guidelines.

Conflict of interest: E.T. is a consultant for Asahi Intecc, Boston Scientific, and KANEKA. The other authors have no conflicts of interest to be declared.

Funding: None declared.

Data availability

The data underlying this article are available in the article and in its online supplementary material.

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