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**CASE REPORT**
*Cardiac imaging*

# An unusual case of stabbing chest pain …literally: a case report

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**Background** Cardiac surgery is associated with a significant risk of potential postoperative complications. We describe a case of a patient with an unusual late cardiac perforation caused by a needle used to fix temporary epicardial pacing wires to the skin, which slowly migrated across subcutaneous tissues for 2 years following postoperative period.

**Case summary** We report a case of middle-aged woman admitted to the cardiac intensive care unit due to suspected acute myocardial infarction. Multimodality imaging revealed the presence of an unusual intracardiac foreign body, located inside the interventricular septum and perforating towards the left atria, complicated by a small intracardiac fistula between septal coronary branches and the right ventricle. Analysis of previous examinations revealed that a needle used to fix temporary epicardial pacing wires to the skin had been left inside the patient, beneath the level of the diaphragm, after cardiac surgery in 2018. This foreign body slowly migrated across the diaphragm, towards the mediastinum, finally lodging inside the heart, after a period of 3 years. The patient was referred to cardiac surgery for foreign body retrieval.

**Discussion** We describe an unusual case of cardiac perforation caused by a needle used to fix these wires to the skin, which migrated across subcutaneous tissues and finally lodged inside the basal interventricular septum and left atria. Full compliance with standardized surgical care bundles, as well as the implementation of a structured incident reporting system, is of upmost importance to prevent postoperative complications and improve surgical care.

**Keywords** Epicardial pacing • Cardiac surgery • Complications • Cardiac perforation • Case report

**ESC Curriculum** 2.4 Cardiac computed tomography • 2.1 Imaging modalities • 3.4 Coronary angiography • 7.5 Cardiac surgery

## Learning points

- Temporary epicardial pacing after cardiac surgery is associated with a non-negligible risk of major complications. Extreme care by medical and nursing staff is required to prevent temporary epicardial pacing malfunction and complications.
- Multimodality imaging is crucial to evaluate the characteristics of foreign intracardiac bodies, for assessing their position and relation to adjacent structures, and to detect associated complications. It is also fundamental for planning the most suited methods for foreign body retrieval.
- Implementation and compliance with surgical care bundles/checklists and standardized incident reporting systems are crucial to improve perioperative care, reduce complications, and mortality.

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## Introduction

Cardiac surgery is associated with a significant risk of potential postoperative complications (PoC). Cardiovascular complications remain the most frequent and dangerous PoC, and include myocardial infarction, cardiac tamponade, infections, bleeding, acute renal failure and neurological complications. We describe a case of a patient with an unusual late cardiac perforation caused by a needle used to fix temporary epicardial pacing wires (TEPWs) to the skin, which slowly migrated across the superficial tissues for 3 years following postoperative period.

## Timeline

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|---|---|
| Day 0 | Visit to the emergency department due to acute chest pain. Hospitalization in cardiac intensive care unit due to suspected acute myocardial infarction. |
| Day 1 | Coronary angiography revealing the absence of coronary artery disease.<br>Identification of intracardiac foreign body. |
| Day 5 | Cardiac computerized tomography (CT) confirms the presence of intracardiac foreign body penetrating through interventricular septum and left atria. |
| Day 6 | Referral for cardiac surgery. |
| Day 7–21 | Hospitalization without any significant complications.<br>Evidence of further migration of the foreign body upwards across the heart. |
| Day 22 | Cardiac surgery for foreign body retrieval and repair of cardiac chambers using extracorporeal circulation. |
| Day 27 | Discharge from cardiac surgery department, without significant complications. |

## Case presentation

A 71-year-old female was admitted to the emergency department (ED) due to acute chest pain. The patient complained of intense stabbing chest pain, which had started 6 h earlier, worsened by deep inspiration, without relieving factors. She denied syncope, dyspnoea, fever, cough, and other relevant symptoms. While the patient was waiting for medical observation, pain had spontaneously improved.

Medical history was remarkable for a percutaneous mitral balloon valvotomy in 1993, due to rheumatic mitral stenosis, followed by cardiac surgery in 2010 due to restenosis, leading to mitral valve replacement with a no. 27 Medtronic Hall mechanical valve prothesis. Reoperation due to aortic rheumatic disease was also required in 2018, and the patient was thus submitted to aortic valve replacement with a no. 19 St Jude mechanical valve, along with tricuspid annuloplasty. Other relevant comorbidities included a history of permanent atrial fibrillation, arterial hypertension, and asthma.

Patient denied tobacco, alcohol, or illicit drug use. Her chronic medication consisted in warfarin-target international normalized ratio (INR) of 3, furosemide 40 mg daily, pantoprazole 40 mg daily, and bronchodilators. Monthly INR records documented a therapeutic INR (in range) in the last 5 months.

Emergency department examination revealed high blood pressure (171/80 mmHg), normal heart rate and no respiratory distress signs. There was no significant jugular venous distension. Femoral and radial pulses were palpable and symmetric. Cardiac auscultation was irregular, with a loud clicking mechanical prothesis sound and a mild (I/VI) aortic systolic murmur. Bilateral basal crackles were audible on pulmonary auscultation. Chest wall palpation did not reveal any tender areas. There was mild peripheral oedema, with no visible signs of hypoperfusion.

Blood analysis showed a normal haemogram, serum electrolytes and renal function, an INR of 2.7 and mildly elevated lactate dehydrogenase (573 IU/L, normal range: 120–246 IU/L) (*Table 1*). C-reactive protein levels were also normal. There was substantial elevation of Troponin I at admission, with a decreasing pattern after serial measurement (6582 > 4825 ng/L, normal range <75 ng/L).

Electrocardiogram showed atrial fibrillation (~60 b.p.m.), borderline right axis deviation, poor precordial R-wave progression, and a slightly prolonged QTc interval, with visible U waves (see Supplementary material online, *Figure S1*). Chest radiograph revealed cardiomegaly, visible mechanical aortic, and mitral prosthetic valves with signs of previous sternotomy, along with an intriguing linear radiopaque image above the level of the aortic valve (*Figure 1* and Supplementary material online, *Figure S2*). This finding was initially overlooked in the ED.

Bedside echocardiography showed bi-atrial dilatation, normal left ventricular dimensions with mild increase in wall thickness, no regional contractile dysfunction and preserved left-ventricular ejection fraction (LVEF 60%). Dilation of the right ventricle was also noted, with mild longitudinal systolic dysfunction. There were no signs of significant aortic or mechanical prothesis dysfunction. Moderate functional tricuspid regurgitation and a high echocardiographic probability of pulmonary hypertension were evident. Proximal ascending aorta dimensions were normal, with no visible dissection signs. There were no apparent intracardiac masses nor pericardial effusion (see Supplementary material online, *Videos S1–S4* and *Figures S3* and *S4*).

The patient was admitted to the cardiac intensive care unit for monitoring and cardiac invasive coronary stratification, due to suspected non-ST segment elevation acute myocardial infarction.

On the next day, patient underwent invasive coronary angiography, showing a right dominant circulation with no coronary atherosclerotic lesions. A radiopaque linear image, resembling an intracardiac needle, apparently lodged in the interventricular septum, was clearly seen, accompanied by an apparent fistula between the septal branches of the left anterior descending artery (LAD) and the right ventricle, presumably caused by this foreign body (*Figures 2* and *3*). Cinefluoroscopy revealed normal motion of both mechanical valves (see Supplementary material online, *Videos S5–S7*).

After careful evaluation of the patient's previous imaging examinations available, a radiopaque foreign body was identified below the level of the diaphragm in a chest radiograph taken days after TEPW extraction, and before patient discharge from the surgical centre in 2018 (*Figure 1B* and Supplementary material online, *Figure S2*). Compared with a chest radiograph taken while the patient still had the TEPW in place, it appears that the length of this foreign

**Table 1 Results from diagnostic and prognostic tests undertaken at admission and throughout hospitalization**

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| Blood analysis | • Blood count: Haemoglobin: 12.3 g/dL (ref: 12.0–15.0 g/dL); leucocytes: $5.9 \times 10^9$/L (ref: 4.5–11.5 × $10^9$/L); platelets: 135 × $10^9$/L (ref: 150–450 × $10^9$/L) |
| | • Coagulation: aPTT: 38.7 s (ref: 24.3–36.8 s), INR: 2.7 |
| | • Kidney function and electrolytes: Creatinine: 0.7 mg/dL (ref: 0.5–1.2 mg/dL); sodium: 140 mEq/L (ref: 135–145 mEq/L); potassium: 4.2 mEq/L (ref: 3.5–5 mEq/L) |
| | • Liver enzymes: AST: 15 IU/L (ref: 3–31 IU/L); ALT: 38 IU/L (ref: 3–31 IU/L) |
| | • LDH: 573 IU/L (ref: 120–246 IU/L) |
| | • C-reactive protein: 0.25 mg/dL (ref: <0.5 mg/dL) |
| | • Troponin I: 6582 ng/mL (ref: <75 ng/L); NTproBNP: 2558 pg/mL (ref: <300 pg/mL) |
| Echocardiography | • Bi-atrial dilatation (left atria: 87 mL/$m^2$, ref: 16–34 mL/$m^2$; right atria: 37 mL/$m^2$, ref: 15–27 mL/$m^2$) |
| | • Normal left ventricular dimension (50 mL/$m^2$, ref: 69 mL/$m^2$) with mild increase in wall thickness (IVS: 11 mm; PW: 8 mm, ref: <10 mm), no regional contractile dysfunction, with preserved ejection fraction (LVEF 60%, ref: ≥55%) |
| | • Slightly dilated right ventricle (basal diameter: 43 mm, ref: 25–41 mm) with reduced systolic function (FAC 32%, ref: ≥35%) |
| | • No signs of mechanical aortic prothesis dysfunction (mean gradient of 7 mmHg, effective orifice area: 1.3 $cm^2$, ref: 1.0 ± 0.2 cm) |
| | • No signs of mechanical mitral valve prothesis dysfunction (mean gradient of 3 mmHg, effective orifice area: 3.5 $cm^2$, ref range: 2.9 ± 0.9 cm) |
| | • Moderate functional tricuspid regurgitation and high echocardiographic probability of pulmonary hypertension |
| | • Normal aortic dimensions. No intracardiac shunts visible |
| | • No intracardiac masses nor pericardial effusion identified |
| Coronary catetherization | • No atherosclerotic coronary epicardial lesions |
| | • Small coronary fistula between septal branches of the anterior descending artery and the right ventricle |
| Cinefluoroscopy | • Normal mechanical aortic and mitral valve prothesis motion |
| | • Foreign intracardiac body |
| Cardiac CT | • Linear metallic structure with dimensions of 3 × 44 mm |
| | • Proximal end located intracavitary, inside the left atria, near the ostia of the atrial appendage, coursing behind the LAD, and the origin of the left circumflex artery |
| | • Distal end perforating deeply into the basal anteroseptal segment of the left ventricle |

body is significantly smaller compared with the needle used to fix the TEPW in the first chest radiograph (*Figure 1A*). This finding raises the suspicion that the needle actually broke, and that the distal end was retained in the subcutaneous tissues after TEPW extraction. This foreign body was not present before cardiac surgery in 2018.

Computerized tomography cardiac scan was then undertaken to assess the anatomic position and relation of this foreign intracardiac body with the cardiac chambers, coronary arteries, and great vessels. Cardiac CT confirmed the presence of a linear structure, with attenuation coefficient consistent with metallic material, with approximate dimensions of 3 × 44 mm. The proximal end of this

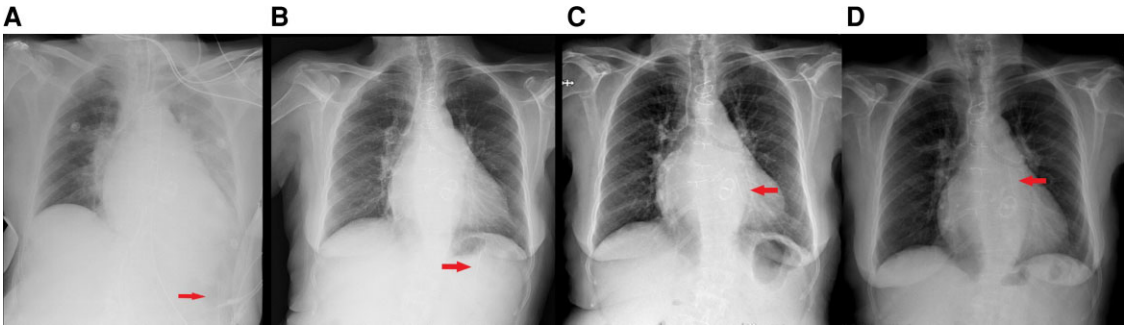


**Figure 1** Chest radiographs (uncropped). (*A*) Chest radiograph taken in the intensive care unit ~24 h after surgery in 2018, showing temporary epicardial pacing wire fixed to the skin by a needle. (*B*) Chest radiograph before discharge in 2018, showing foreign body below the diaphragm. (*C*) Chest radiograph taken at index admission (2021), showing the foreign body projected at the level of the cardiac silhouette. (*D*) Chest radiograph taken a week after index admission, revealing further migration of the foreign body.

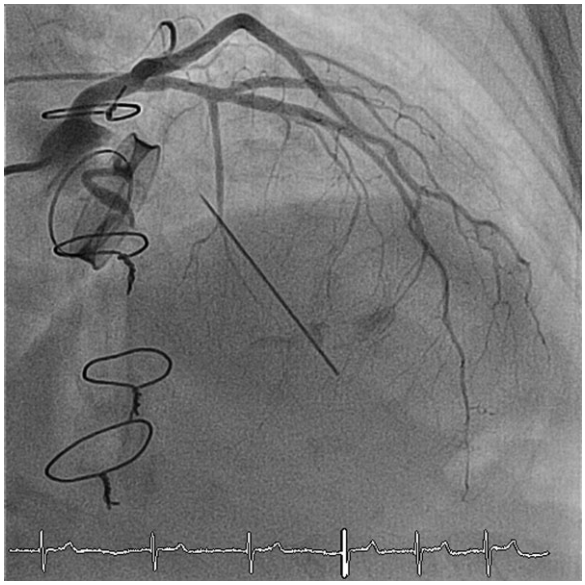

**Figure 2** The AP cranial view of coronary catheterization showing the absence of coronary epicardial atherosclerotic lesions and a foreign intracardiac body, presumably located at the level of the interventricular septum.

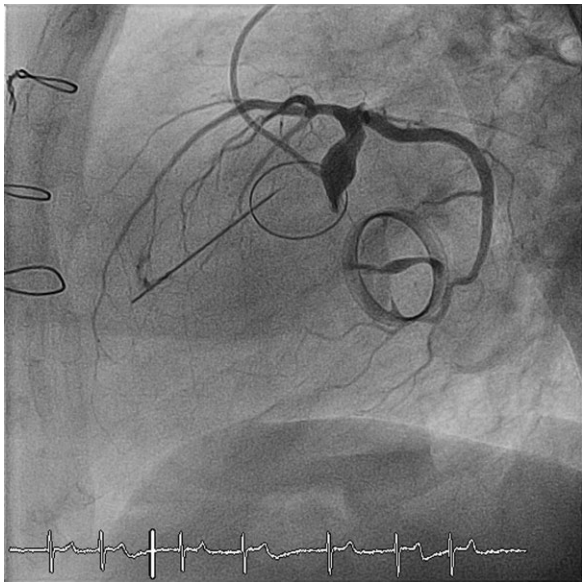

**Figure 3** Lateral/profile view (90°) of coronary catheterization showing the absence of coronary epicardial atherosclerotic lesions and a foreign intracardiac body, presumably located at the level of the interventricular septum.

foreign body was located intracavitary, inside the left atria, near the ostia of the atrial appendage, running a course towards the anterior septum, initially with an epicardial location (running behind the LAD and the origin of the left circumflex artery), and then perforating deeply into the basal anteroseptal segment of the left ventricle (*Figures 4* and *5*, Supplementary material online, *Figures S5–S13*).

The patient remained asymptomatic during the entire admission. However, serial chest radiographs demonstrated migration of the foreign body upwards across the chest during hospitalization (*Figure 1C* and *D*, Supplementary material online, *Figure S2*), without apparent cardiovascular complications. The patient was eventually transferred to the cardiac surgery department of another hospital, for foreign body retrieval and repair of the perforated cardiac chambers.

## Discussion

Postoperative complications after cardiac surgery are frequent and have been described in up to 66.6% of patients in recent observational registries.[1] Blood transfusion necessity, atrial fibrillation, prolonged mechanical ventilation, and renal failure are the most frequent PoCs.[1] Cardiac tamponade, reoperation for acute valvular dysfunction, and sternal wound infection are much more infrequent complications, although associated with a significantly higher mortality. Postoperative complications also impact on long-term survival, with 5-year mortality being significantly higher in patients who have experienced a PoC in comparison with patients who have had an uncomplicated postoperative convalescence (96.3 vs. 89.8%).[1,2]

Temporary epicardial pacing wire insertion is routine practice in cardiac surgery patients, although controversy exists in this matter, since only a small minority of patients require in fact pacing therapy to wean from cardiopulmonary bypass.[3,4] Temporary epicardial pacing wires are usually manufactured with a small needle on one end, used to embed the wire in the myocardium, after which the needle is cut-off. Some wires may be coiled/clipped to assist fixation into the myocardium or loosely sutured to the surface of the heart. On the other end of the TEPW, a large needle allows to penetrate the body wall, bringing the wires to the surface, near the epigastrium, usually secured with a loop of the wire itself or with a simple skin suture.

Various complications of TEPW have been described, either in the immediate period following insertion, during prolonged use or after wire removal. Bleeding caused by puncture of the atria or ventricles and abdominal wall or visceral perforation are possible complications during wire insertion. Removal of TEPW is associated with a non-negligible risk of major complications (0.4%). Bleeding, either from laceration of the cardiac chambers or laceration/avulsion of coronary grafts, cardiac tamponade, haemothorax, infection/migration of retained wires, and bronchocutaneous fistulas, although rare, have all been previously described.[3–6]

It is estimated that at least 4 million deaths occur in the first 30 days after surgery globally, each year.[7] Previous registries report that patients may be unintentionally harmed in almost 4% of hospital admissions, of which nearly 50% are associated with a surgical intervention, emphasizing the need to focus on safety and standardizing protocols for healthcare improvement in surgical care.[8] Improvement in postoperative results is a team effort, focusing on prevention, confirmation of patient data and treatment goals,

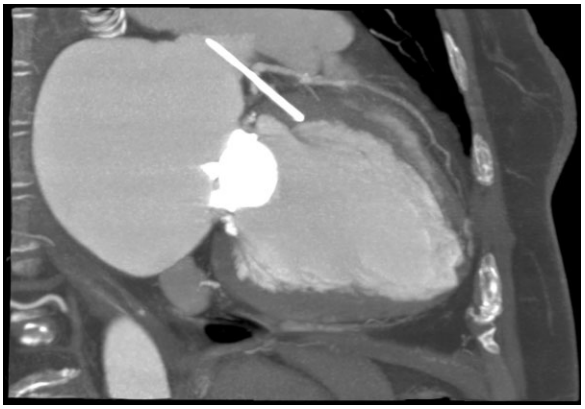

**Figure 4** Cardiac computerized tomography showing intracardiac metallic foreign body, with dimensions of 3 × 44 mm. The proximal end is located intracavitary, inside the left atria, near the ostia of the atrial appendage, running a course towards the anterior septum [modified LV 2 chamber view, left heart early arterial phase], initially with an epicardial location, running behind the left anterior descending artery and the origin of the left circumflex artery.

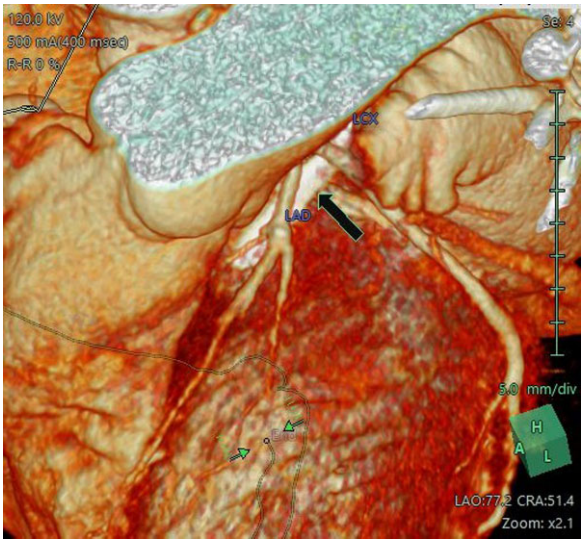


**Figure 5** 3D volume rendering reconstructions showing the distal end of the intracardiac metallic foreign body perforates deeply into the basal anteroseptal segment of the left ventricle.

recognizing possible complications, applying standardized operating procedures (SOPs), including pre-skin closure protocols that guarantee surgical material withdrawal and adequate haemostasis, and postoperative standardized incident reporting systems, which must be ensured by all members of the surgical team.

Knowledge of how to use these reporting systems, recognition of incidents in clinical practice and the capacity to overcome a plethora of psychological and practical barriers are fundamental to guarantee an efficient incident reporting system. Previous reports have found that severity of harm caused, type of incident, and health profession significantly affected the likelihood of incident reporting.[9] Several studies have found that fear and safety issues were not significant restrictions to incident reporting by health professionals.[8–10] Underreporting of incidents involving SOPs, mainly due to human-based error, may contribute to more than a third of perioperative adverse events, implying the existence of a major area for care improvement.[10]

Studies evaluating the effectiveness of perioperative safety checklists revealed a significant 56% reduction of in-hospital 30-day mortality after surgery, in patients with completed checklists, compared with patients with partially completed or non-completed checklists, who had unchanged mortality rates.[11] The implementation of a bundle of care to reduce postoperative surgical site infections showed that increased compliance with a standardized bundle was associated with a significant 36% reduction in infection rate.[12]

We present a rare case of cardiac chamber perforation caused by migration of a needle used to secure TEPW to the skin. During almost 3 years, our patient had a foreign body which slowly migrated from the superficial tissues of the epigastrium, presumably crossing the diaphragm to the mediastinum, and perforating the heart in the anterior septum towards the left atria. Unfortunately, there are no imaging examinations available between 2018 and 2021 to document this hypothesis (also, the patient remained asymptomatic during this period). However, considering the location and trajectory of the foreign body, arterial/venous embolization to the heart, which has previously been described in other settings, is unlikely.[13] Retrospective analysis of the patient's complaints of pleuritic chest pain might be explained by migration across the pericardium, before lodgement of the foreign body inside the septum with rupture of septal branches (which may explain myocardial damage and Troponin I elevation), although there were no classical electrocardiographic manifestations at admission. Fortunately, cardiac perforation was not accompanied by pericardial effusion, which is probably explained by perforation of a more muscular chamber (left ventricular septum) rather than atria or atrial appendage. The cardiac fistula described, presumably caused by direct trauma to small septal vessels, is small, probably haemodynamically non-significant and does not require specific therapy.

Multimodality imaging is crucial for the evaluation of the characteristics of foreign intracardiac bodies, to assess their position and relation to adjacent structures, associated complications and for planning of the most suited methods for retrieval.

This case highlights a rare but possible complication of TEPW and the importance of compliance with standardized surgical care bundles, as well as the importance of implementing a structured incident reporting system. Appropriate training and implementation of local protocols standardizing TEPW material selection, methods of fixation, troubleshooting, and adequate extraction are highly desirable for this purpose. We did not find any reports regarding a broken or retained needle in the surgical records from the patient in 2018. We cannot ignore that compliance with a proper structured bundle regarding TEPW management could have prevented this PoC. An efficient incident reporting system could also have led to an earlier

reporting of the retained foreign body, facilitating extraction, and potentially preventing cardiac perforation.

## Conclusion

Temporary epicardial pacing wire is common practice after cardiac surgery, although complications are not infrequent. We describe an unusual case of cardiac perforation caused by a needle used to fix TEPW to the skin, which presumably migrated across subcutaneous tissues and finally lodged inside the anterior left ventricular septum and left atria. Full compliance with standardized surgical care bundles as well as the implementation of a structured incident reporting system is crucial to prevent POCs and improve surgical care.

## Lead author biography

João Santos is currently working as a cardiology resident at Centro Hospitalar Tondela-Viseu. He concluded his master's degree on Medicine in 2016 in Faculdade de Medicina da Universidade de Coimbra.

## 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.

**Conflict of interest:** None declared.

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## Data availability

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

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