

# A case report of left ventricular thrombus formation following aggressive decongestion treatment

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## Background

Intracardiac thrombi are a complication associated with cardiomyopathies. In heart failure with reduced ejection fraction, there is a hypercoagulable state that can increase the incidence of left ventricular thrombus and result in higher risk of thromboembolism, either manifested as stroke or as peripheral thromboembolic event. Haemoconcentration following decongestion treatment may enhance blood viscosity.

## Case summary

A 63-year-old man with known long-standing heart failure (HF) of ischaemic aetiology and not any prothrombotic risk, admitted with congestive HF and treated with aggressive decongestion treatment with intravenous loop diuretics. During his hospital stay, and following decongestion and haemoconcentration, a left ventricular (LV) intracardiac thrombus formation was detected by echocardiography, which occurred in the absence of a recent myocardial infarction or adverse LV remodelling. The patient was treated with oral anticoagulation therapy. There was a complete resolution of the thrombus on repeat transthoracic echocardiography after 4 weeks of treatment.

## Discussion

Aggressive decongestive treatment, haemoconcentration and increased blood viscosity following HF decompensation may serve as a trigger for intracardiac thrombus formation under the appropriate prothrombotic background. Appropriate primary antithrombotic prophylaxis is an issue raised concerns and vulnerable patients need closed clinical and imaging follow-up.

## Keywords

Case report • Viscosity • Intracardiac thrombus formation • Heart failure • Diuretics • Decongestion treatment

## ESC Curriculum

6.4 Acute heart failure • 6.2 Heart failure with reduced ejection fraction • 2.2 Echocardiography

## Learning points

- Patients with heart failure with reduced ejection fraction (HFrEF) and evidence of low flow and blood stasis in echocardiogram should regularly checked for intracardiac thrombus.
- Aggressive decongestive treatment in patients with HFrEF and intracavitary low blood flow velocities can lead to thrombus formation.
- Antithrombotic prophylaxis, in patients with HFrEF, low blood flow and blood stasis, may be considered when significant decongestion is planned.

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## Introduction

Intracardiac thrombi are a complication associated with cardiomyopathies.<sup>1</sup> In recent years, the incidence of left ventricular (LV) thrombi complicating heart failure (HF) of ischaemic aetiology has decreased because of the improvement in reperfusion strategies.<sup>2</sup> But still, in heart failure with reduced ejection fraction (HFrEF), there is a hypercoagulable state that can increase the incidence of LV thrombus and result in a higher risk of thromboembolism.<sup>3</sup>

## Timeline

### Chronological series of the patient's events

Patient's medical history (4 months before the index event)	Patient with known long-standing heart failure (HF) of ischaemic aetiology and severely reduced left ventricular (LV) ejection fraction ( <a href="#">Figure 1</a> and <a href="#">Video 1</a> ).
20 February 2021	Presents with symptoms and signs of biventricular HF. Transthoracic echocardiography shows biventricular dilatation with severe systolic dysfunction (~ejection fraction 15%) ( <a href="#">Figure 2A–F</a> and <a href="#">Video 2</a> ).
20–23 February 2021	Satisfactory response to diuretic treatment. An achievement of a negative fluid balance of 14 L with body weight reduction from 74 to 60 kg.
23 February 2021	Transthoracic echocardiographic study reveals an LV intracavitary mass, attached on the lateral LV wall ( <a href="#">Figure 3A–C</a> and <a href="#">Video 3</a> , <a href="#">Supplementary material online</a> , <a href="#">Videos S1</a> and <a href="#">S2</a> ). Initiation of enoxaparin s.c.
24 February 2021	The patient develops right drop foot. Brain computed tomography (CT) reveals findings compatible with ischaemic stroke ( <a href="#">Figure 3D</a> ).
26 February 2021	New brain CT reveals no haemorrhagic conversion of stroke ( <a href="#">Figure 3E</a> ).
2 March 2021	Initiation of oral anticoagulation (acenocoumarol).
3 March 2021	New transthoracic echocardiography: no significant changes to previous exam. Patients gets discharged on acenocoumarol and medical therapy for HF.
7 April 2021	Follow-up transthoracic echocardiographic exam: complete resolution of the LV thrombus ( <a href="#">Figure 4</a> and <a href="#">Supplementary material online</a> , <a href="#">Video S3</a> ).

## Case presentation

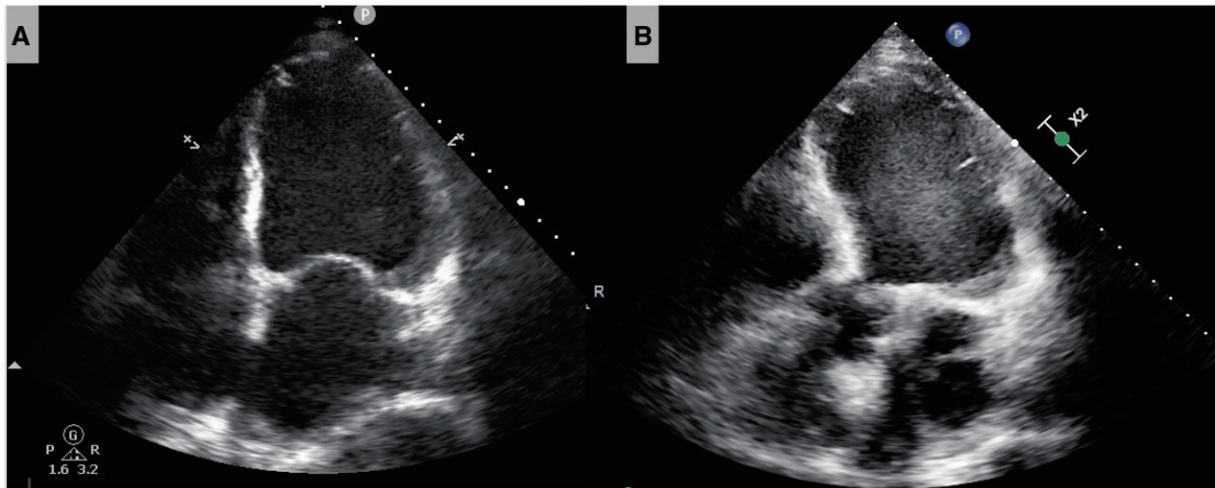
A 63-year-old patient, with known long-standing HF of ischaemic aetiology (following myocardial infarction—19 years ago—, in the territory perfused by the left anterior descending coronary artery) and severely reduced LV ejection fraction (LVEF) ~15–20% ([Figure 1](#) and [Video 1](#)) attended the outpatient HF clinic because of progressively worsening dyspnoea even at rest (New York Heart Association IV) and paroxysmal nocturnal dyspnoea. There was no history of previous thromboembolic disease; atrial fibrillation or flutter has not been recorded. The patient was on treatment with bisoprolol, eplerenone, aspirin, atorvastatin, and sacubitril/valsartan. The patient has recently stopped treatment with furosemide 40 q.d.

On physical examination, he appeared diaphoretic, dyspnoeic, orthopnoeic, and tachypnoeic with prominent jugular venous distension, hepatosplenomegaly, and bilateral peripheral oedema.

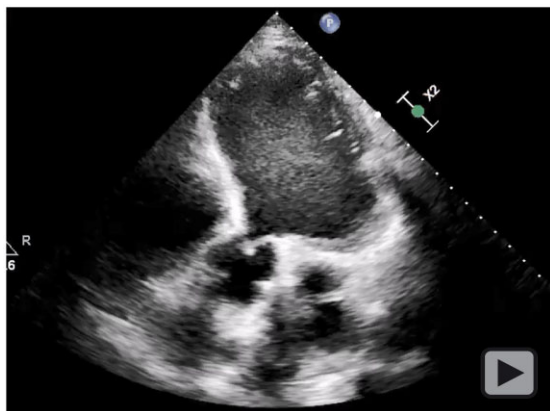
In the initial workup, the 12-lead electrocardiogram showed sinus rhythm with right bundle branch block morphology but without signs of acute myocardial ischaemia. Chest X-ray ([Figure 2A](#)) revealed cardiomegaly, pulmonary venous congestion, and pleural effusion. No episodes of atria or ventricular tachyarrhythmias, as a possible trigger of patient's deterioration were detected on implantable cardioverter-defibrillator interrogation. The transthoracic echocardiographic study ([Video 2](#)) confirmed the significantly impaired LVEF ~15% with markedly dilated left ventricle (LV end-diastolic diameter 7.9 cm), apical aneurysm, and inferior akinesis ([Figure 2B and C](#)). Based on transmitral inflow profile (peak E- and A-wave velocity: 92 and 38 cm/s, respectively) and tissue Doppler velocities (mean velocity of diastolic mitral annular motion  $e'$ : 4 cm/s,  $E/e'$ : 23) ([Figure 2D](#)), LV filling pressures were estimated significantly elevated. Right ventricular function was also impaired (tricuspid annular plane systolic excursion: 12 mm, peak systolic velocity of lateral tricuspid annulus SRV: 6 cm/s). Furthermore, spontaneous echo contrast in the LV cavity as evidence of low flow state and blood stasis<sup>4</sup> was noted, though a finding that had been regularly observed during the patient's scheduled follow-up ([Figure 2E and F](#)) and therefore has not been further evaluated with cardiac magnetic resonance (CMR) imaging or echo contrast study. On admission, a significant increase of natriuretic peptides (brain natriuretic peptides > 5000 pg/mL) was observed, while troponin I (TnI) levels were below the 99th percentile (TnI: 29 pg/mL). Serum creatine level was 1.1 mg/dL with an estimated creatine clearance of 60 mL/min. Haematocrit (Hct) was 45%, blood albumin concentration was 3.7 g/dL and total blood proteins was 7.1 g/dL. Serum osmolarity was estimated at 290 mOsm/L. The patient has normal full blood count and no evidence of activated coagulation as indicated by prothrombin time, activated partial thromboplastin time, D-dimers, and fibrinogen levels.

After systematic exclusion of other possible triggers of acute decompensation, the patient's clinical presentation was attributed to poor compliance to medical treatment.

The patient was hospitalized and treated with intravenous (IV) loop diuretics 60 mg b.i.d., with thromboprophylaxis (s.c. enoxaparin 40 mg q.d.), and with proton pump inhibitor prophylactic treatment according to European Society of Cardiology (ESC) guidelines.<sup>4</sup> The dose of b-blockers was down-titrated. The rest of the outpatient



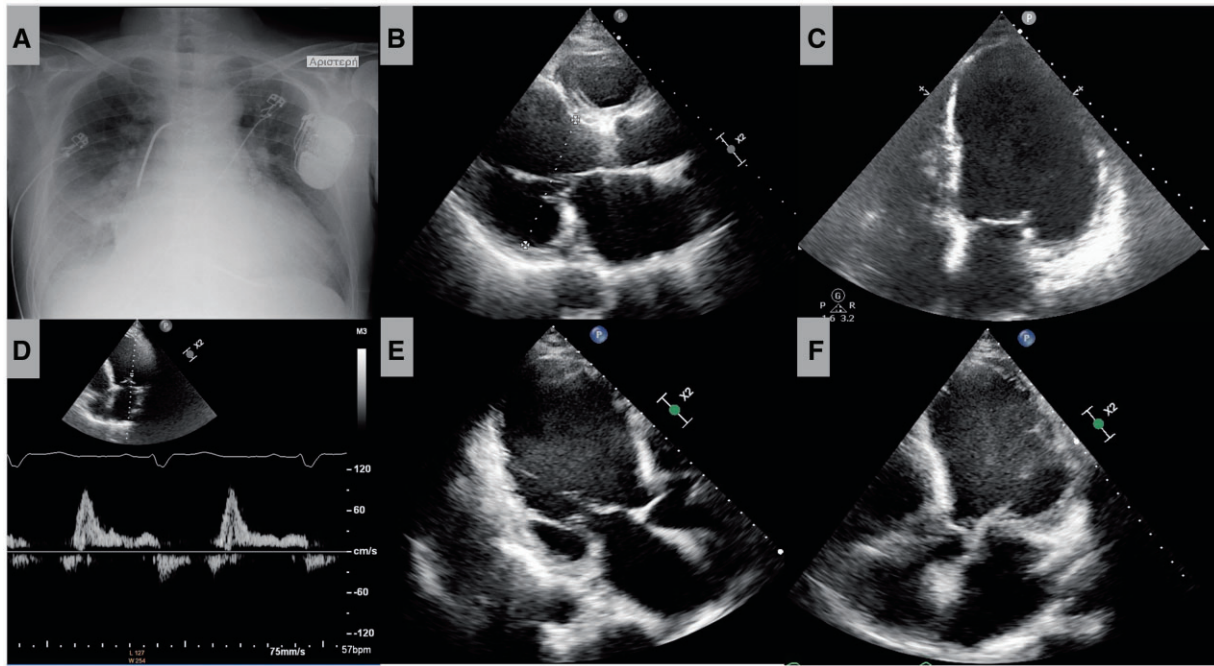
**Figure 1** Echocardiographic study from the patient records 4 months before the index event. (A) Apical four-chamber view; significantly dilated left ventricle with aneurysm of the left ventricular apex. (B) Apical five-chamber view with spontaneous echo contrast.



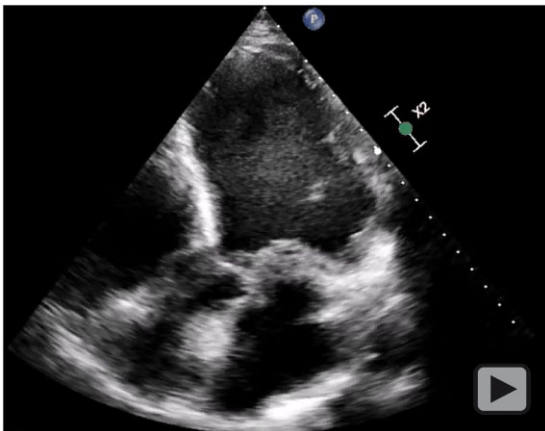
**Video 1** Echocardiographic study from the patient records 4 months before the index event. Apical five-chamber view. Significantly dilated left ventricle with aneurysm of the left ventricular apex and spontaneous echo contrast.

treatment has not been modified. The response to loop diuretics was satisfactory with 105 mEq/L of sodium at a urine spot sample two hours following administration of IV furosemide. The next 3 days the patient achieved a negative fluid balance of 14 L with bodyweight reduction from approximately 74 kg to 60 kg. On the regular blood tests, no serum electrolyte imbalance was noted and at Day 3 of hospitalization serum osmolarity was estimated 299 mOsm/L, while Hct was found 50% and total proteins 7.0 g/dL.

On the third day of his hospitalization, the transthoracic echocardiographic study by the same echocardiographer, revealed an LV intracavitary mass, attached to the lateral LV wall. The mass appeared highly mobile, echo-lucent with protrusion to the LV cavity, and after contrast injection, a filling defect, consistent with intracardiac thrombus was observed (Figure 3A–C; Video 3 and Supplementary material online, Videos S1 and S2). The patient was treated with s.c. enoxaparin 80 mg b.i.d. On the next day, the patient developed right peripheral lower extremity weakness (drop foot) and brain computed tomography (CT) revealed findings compatible with ischaemic stroke (Figure 3D and F). After exclusion of haemorrhagic conversion on serial CT imaging, oral anticoagulation with vitamin K antagonists was initiated and the patient was discharged, euvolaemic, asymptomatic, and with improved neurological deficit on treatment with bisoprolol, eplerenone, atorvastatin, sacubitril/valsartan, furosemide, acenocoumarol, and proton pump inhibitors. Treatment with sodium-glucose co-transporter 2 inhibitor although recommended by the new ESC guidelines<sup>5</sup> has not been prescribed since it has not yet been incorporated in the national health insurance system. Continuation of acenocoumarol for at least 3 months has been recommended and according to echocardiographic resolution of LV thrombi or further evidence indicating long-term anticoagulation. To this line, a brain CMR was suggested for detection of micro-thrombi. On follow-up transthoracic echocardiogram 4 weeks later, there was a complete resolution of the intracardiac thrombus (Figure 4 and Supplementary material online, Video S3). The patient had no symptoms or signs of volume overload and was fully compliant with the medical treatment.



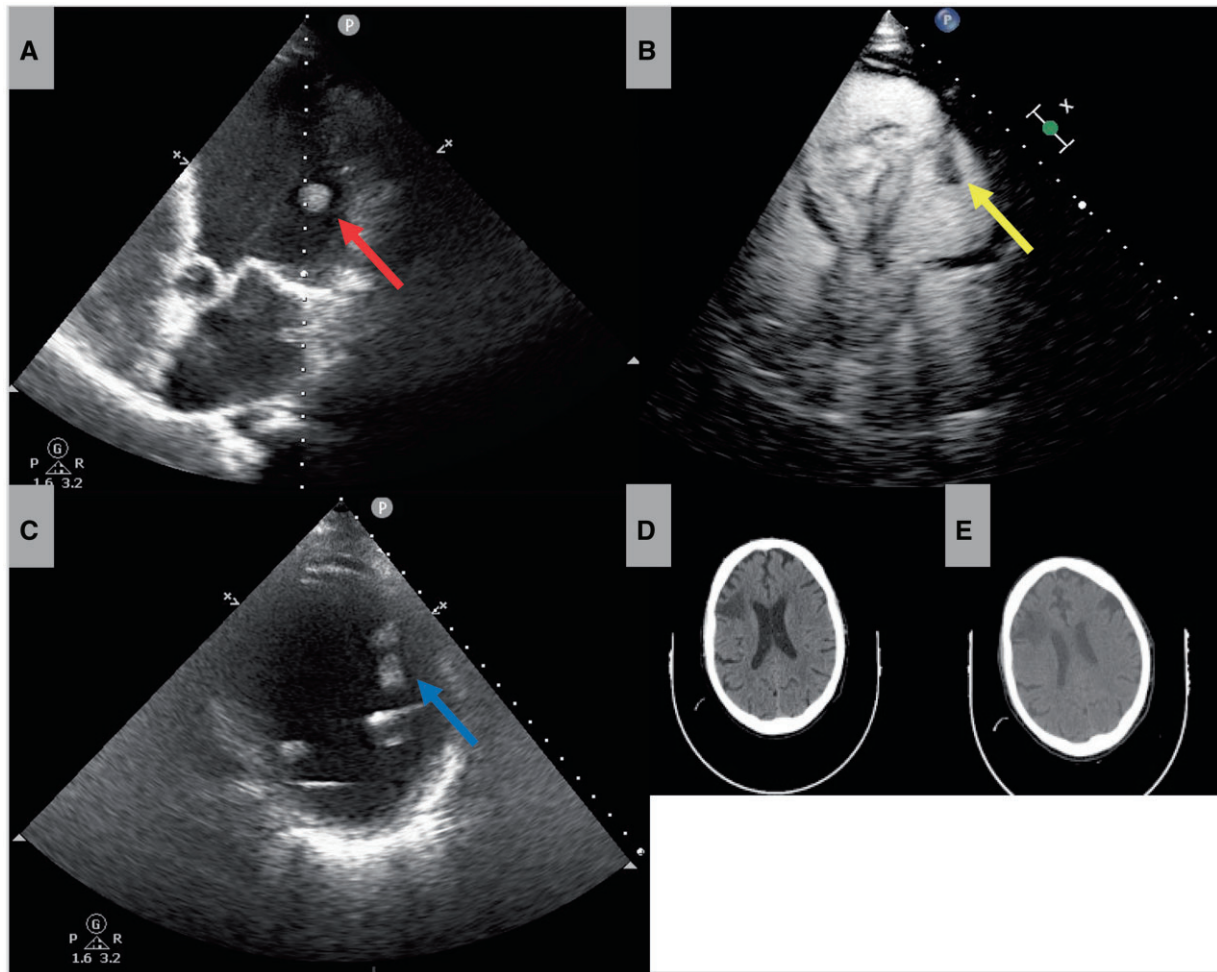
**Figure 2** Diagnostic tests at admission. (A) X-ray in admission: cardiomegaly, upper lobe pulmonary venous, and pleural effusion. (B) Echocardiography, parasternal long-axis view: Severely dilated left ventricle with end-diastolic diameter 7.92 cm. (C) Echocardiography, apical four-chamber view. (D) Echocardiography, transmittal flow Doppler with severely depressed A wave and E wave  $\gg$  A wave. (E) Echocardiography, apical three-chamber view. (F) Echocardiography, apical five-chamber view. Significantly dilated left ventricle with thinning of the left ventricular apex. Evidence of spontaneous echo contrast with no evidence of intracardiac mass.



**Video 2** Echocardiographic study at the first date of hospitalization due to decompensation. Apical five-chamber view. Significantly dilated left ventricle with thinning of the left ventricular apex, spontaneous echo contrast, and no evidence of intracardiac mass.

## Discussion

In the case we present, a patient with ischaemic cardiomyopathy with severely reduced LVEF and acute decompensation with pulmonary and systemic congestion, developed a cardioembolic stroke after aggressive decongestive therapy. Virchow's triad refers to the three primary factors or predisposing conditions that influence thrombus formation. This includes blood stasis, vessel wall injury, and hypercoagulability. The echocardiographic finding of intracavitary stasis expressed as spontaneous echo contrast is a relatively common finding in patients with HFrEF, especially of ischaemic origin. Importantly, left anterior descending artery-related infarcts are a predictor of LV thrombus formation independently of other factors such as multivessel disease or LVEF.<sup>6</sup> However, there is no solid data to support anticoagulant therapy over antiplatelet treatment among patients with reduced LVEF who were in sinus rhythm,<sup>7,8</sup> and a decision on proper antithrombotic treatment should be taken on an individualized basis. Our patient had a severely depressed LV function with excessive regional wall motion abnormalities and already signs of intracavitary low blood flow velocities while no other

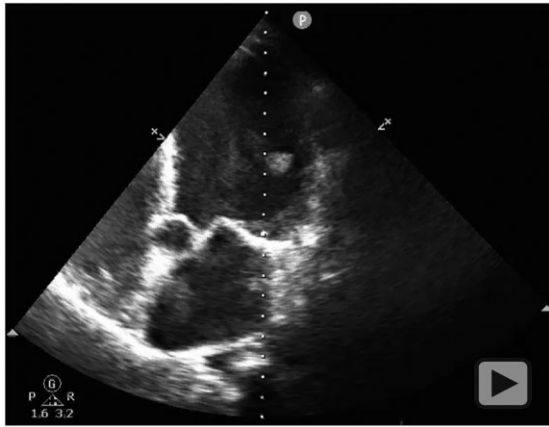


**Figure 3** Diagnostic tests on the third day of hospitalization after significant decongestion of the patient. (A) Echocardiography, apical five-chamber view. Significantly dilated left ventricle with thinning of the left ventricular apex and protruding mass with thrombus characteristics at the mid anterolateral wall. The red arrow shows the protruding mass. (B) Echocardiography, apical five-chamber view, two-dimensional echo contrast study. Significantly dilated left ventricle with thinning of the left ventricular apex and filling defect, consistent with intracardiac thrombus at the mid anterolateral wall. The yellow arrow shows the filling defect. (C) Echocardiography, parasternal short-axis view at the papillary muscle level. Protruding mass with thrombus characteristics at the anterolateral left ventricular wall (blue arrow). (D) Brain computed tomography showing findings compatible with stroke in the right frontal region. (E) Brain computed tomography with contrast showing findings compatible with stroke in the right frontal region.

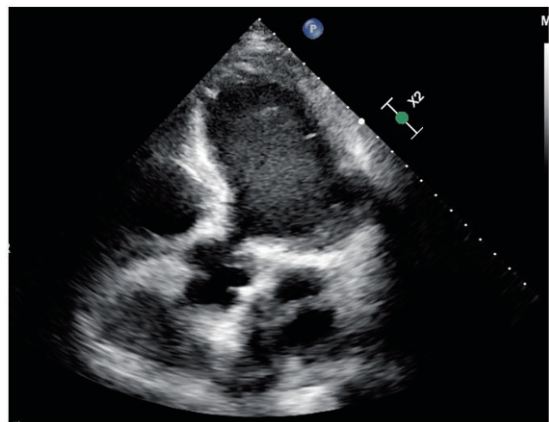
acquired reasons for acquired hypercoagulability have been detected. Blood viscosity is negatively correlated to LVEF.<sup>9</sup> Furthermore, high doses of IV loop diuretics can cause haemoconcentration as well as an increase of red blood cell aggregation,<sup>10–12</sup> increasing the thrombogenic milieu. De Simone *et al.*<sup>13–15</sup> described that an increase of 1% in Hct can result in an up to a 4% increase in blood viscosity. In our case, a patient with severely impaired LVEF and already intracavitary stasis was treated with aggressive decongestive therapy, which may have caused relative haemoconcentration and increased blood viscosity as it can be evaluated based on the total proteins and the Hct. As far as ESC guidelines are concerned, all patients with signs or symptoms of fluid overload are

recommended to be treated with IV diuretics.<sup>4</sup> Besides monitoring of patient's cardiorespiratory status, urine output, renal function, electrolytes, and Hct may also be serially monitored as a surrogate of blood viscosity.

Whether, aggressive decongestive treatment, relative haemoconcentration, and increased blood viscosity following acute decompensated HF may serve as a trigger for intracavitary thrombus formation under a pre-existing prothrombotic background is a matter merit further research. Although, a direct cause and effect relationship cannot be established, appropriate antithrombotic treatment, as primary prophylaxis is an issue raising concerns, in patients treated for HF decompensation.



**Video 3** Echocardiographic study at the third date of hospitalization after significant decongestion of the patient. Apical five-chamber view, two-dimensional echo study. Significantly dilated left ventricle with thinning of the left ventricular apex and protruding mass with thrombus characteristics at the mid anterolateral wall.



**Figure 4** Echocardiographic study at follow-up after 4 weeks. Apical five-chamber view. Complete resolution of the thrombus.

## Lead author biography



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## 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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