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CASE REPORT
Other

The clot thickens: role of mechanical thrombectomy in intermediate to high-risk pulmonary embolism in the peri-operative setting—a case report

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Background European Society of Cardiology (ESC) recommends catheter-directed thrombectomy for management of high-risk pulmonary embolism (PE) with contraindications to thrombolytics or in patients that have failed thrombolytic therapy, as well as intermediate-risk PE with haemodynamic deterioration. In this case report, the role of catheter-directed mechanical thrombectomy is highlighted in the urgent peri-operative setting.

Case summary A 71-year-old female presented with 10 days of progressive lower extremity weakness and was found to have malignant cord compression along with incidental saddle, intermediate–high-risk PE that extended to all lobes on chest computed tomography. Given the intermediate to high-risk PE with acute cor pulmonale, urgent need for surgery, and risk of haemodynamic collapse upon induction of general anaesthesia, the decision was made to proceed with urgent percutaneous treatment of the PE. Percutaneous catheter-directed thrombectomy was successfully performed. The patient returned to the intensive care unit in stable condition and was able to then receive urgent cord decompression and further treatment for malignancy with no complication.

Discussion In this case, single-session thrombectomy resulted in rapid reduction of pre-operative cardiopulmonary risk by alleviating the right ventricular strain, allowing urgent cord decompression surgery to proceed with optimized haemodynamics, no bleeding events, and no further oxygen requirements. While peri-operative risk stratification for cardiovascular outcomes is well established in current guidelines, there are no clear guidelines for peri-operative risk stratification in the setting of pulmonary embolism. The importance of the multidisciplinary PE Response Team is thus emphasized, as well as the importance of continuous evaluation of clinical decompensation in PE.

Keywords Pulmonary embolism • Mechanical thrombectomy • Cardiac preoperative risk-stratification • Case report

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Learning points

- To identify current ESC key guidelines for the identification and management of intermediate–high-risk pulmonary embolism.
- To identify possible case-specific indications for mechanical thrombectomy in the setting of urgent surgery in a patient with acute pulmonary embolism despite no contraindication for thrombolytic therapy.
- To recognize the call for clear cardiac peri-operative risk stratification guidelines in the setting of pulmonary embolism.

Introduction

2019 European Society of Cardiology (ESC) acute pulmonary embolism (PE) guidelines outline clear risk-stratification in the setting of acute PE in the absence of haemodynamic instability.[1] This involves the use of the Pulmonary Embolism Severity Index (PESI), simplified PESI, and Hestia criterion. These clinical signs of severity, as well as presence of severe comorbidities, RV dysfunction on transthoracic echocardiogram (TTE)/computed tomography of the pulmonary arteries (CTPA), and elevated troponin indicate the need to escalate risk classification of PE. Rescue reperfusion treatment is then considered.[1] Though there is promising data on significant RV afterload reduction with catheter-directed therapy,[2] there is lack of randomized control data on enhanced clinical outcomes when catheter-directed therapy is compared against systemic anticoagulation.[3] In this case, the value of percutaneous catheter-directed mechanical thrombectomy in the urgent peri-operative setting where rescue reperfusion treatment is indicated is highlighted.

Timeline

Timeline	Description
Day 0	Patient presented with lower limb weakness and was found to have malignant cord compression with incidental saddle, intermediate–high-risk pulmonary embolism (PE) on computed tomography (CT) chest, right ventricle/left ventricle (RV/LV) ratio nearly 2:1, and elevated troponin.
Day 0	Pulmonary Embolism Response Team (PERT) activated. Systemic heparin started.
Day 0—Start of intervention, hour 00:00	Mechanical thrombectomy successfully performed on bilateral PAs. Inferior vena cava (IVC) filter placed.
Day 0—end of intervention, hour 02:15:00	PA pressures 26/6 mmHg (mean: 15 mmHg from 34/12 mmHg (mean: 21 mmHg).
Day 1	Echocardiogram showed resolution of RV systolic dysfunction.
Day 2	Patient underwent successful neurosurgical intervention.
Day 19	Patient returned home. She regularly followed up with Radiation Oncology for further treatment of malignancy. Maintained on enoxaparin.
Day 60	Decision made to maintain IVC filter permanently with cardiology.

Case presentation

A 71-year-old female with past medical history of hypertension presented with 10 days of progressive lower extremity numbness and weakness. Magnetic resonance imaging (MRI) demonstrated likely metastatic malignant mass causing cord compression. She received intravenous fluids and dexamethasone. Initial blood pressure was 88/66 mmHg, heart rate of 92 b.p.m., respiratory rate of 26, and oxygen saturation of 91% on room air. Cardiopulmonary exam was unremarkable. Hypotension was thought to be neurogenic. Electrocardiogram was significant for anterior T wave inversions and S1Q3T3 (*Figure 1*). Computed tomography (CT) with intravenous contrast of the chest and abdomen was done as further malignancy workup, revealing right lower lobe mass (likely primary lung malignancy), with large saddle PE from the main PA with extension into all five lobes (*Figure 2*). Computed tomography was significant for right ventricle/left ventricle (RV/LV) ratio nearly 2:1 consistent with right heart strain (*Figure 2*). Troponin was elevated to 1.84 ng/mL. Heparin infusion was initiated. Admission echocardiogram was not obtained due to urgency of cord compression. PE Response Team (PERT) was activated.

Per multidisciplinary discussion involving the PERT team, cardiology, and neurosurgery, patient was determined to need urgent spinal cord decompression surgery to avoid paralysis. While the systolic blood pressure intermittently dropped <90 mmHg, it did not sustain <90 mmHg for >15 min. Given intermediate–high-risk PE with acute cor pulmonale, urgent need for surgery, and risk of haemodynamic collapse upon induction of general anaesthesia, decision was made to proceed with urgent percutaneous treatment of the PE. Neurosurgery deemed that administering local thrombolysis with tissue plasminogen activator was not necessarily contraindicated. It was then decided to pursue mechanical thrombectomy and IVC filter placement in a single session. The goal was to alleviate right heart strain swiftly while avoiding prolonged catheter-directed

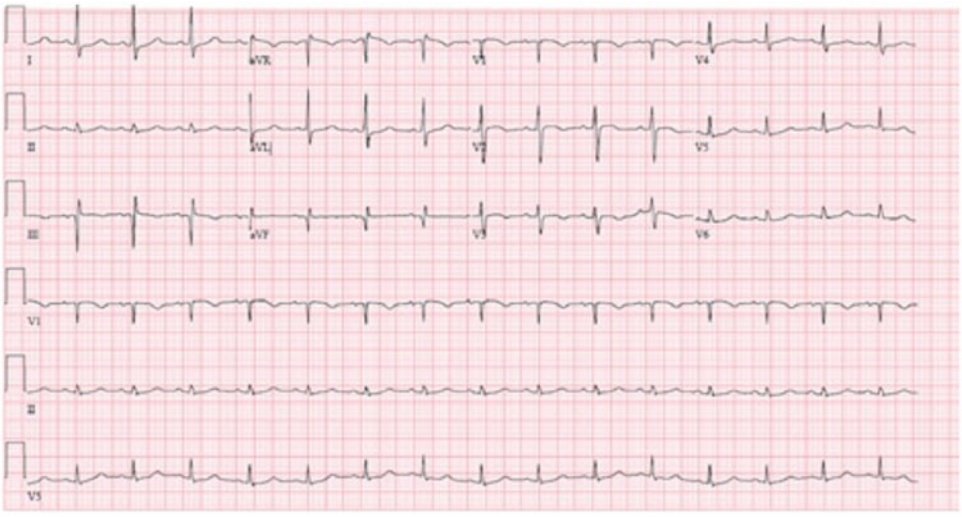

Figure 1 Admission electrocardiogram. Electrocardiogram significant for S1Q3T3 with anteroseptal T wave inversions.

thrombolytic infusion to allow patient to undergo urgent surgery, in addition to reducing bleeding risk.

The patient was brought to the cardiac catheterization lab. At case start, blood pressure 128/76 mmHg. Pulmonary artery catheterization was performed via an 8 Fr sheath in the right femoral vein demonstrating PA pressure of 34/12 mmHg (mean: 21 mmHg). An Amplatz Super Stiff wire was placed in the right interlobar artery. A 26 Fr Gore Dryseal sheath (Gore, Flagstaff, AZ, USA) was introduced to accommodate the FlowTriever system (Inari Medical Inc., Irvine, CA, USA), which consists of a 24 Fr, trackable, 95 cm long aspiration catheter used to mechanically retrieve clot.

Bilateral PAs were selectively engaged with the T24 FlowTriever system. Thrombectomy was successfully performed bilaterally. Multiple aspirations were made with significant visible thrombus extracted (*Figure 3*). Approximately 300 cc of blood loss was noted. Systemic blood pressure remained 103–118/66–77 mmHg. Repeat PA pressures improved to 26/6 mmHg (mean: 15 mmHg). Pulmonary angiogram showed near complete restoration of pulmonary blood flow to the right and left sides (*Figure 3*). Finally, an IVC filter was placed.

The patient returned to ICU on room air with stable blood pressure to 118/71 mmHg. Echocardiogram showed resolution of RV and RA dilation, with normal RV systolic function (*Figure 4*). The patient remained haemodynamically stable.

Two days after thrombectomy, the patient underwent successful C4–C7 laminectomy, C6–C7 corpectomy, and C3–T3 posterolateral fusion. Estimated blood loss was 3.1 L, requiring transfusion. No cardiopulmonary issues occurred post-operatively. Therapeutic anticoagulation was ultimately resumed, and the patient was discharged shortly after. The patient continued to follow with Radiation Oncology for further treatment of primary lung and metastatic malignancy and was maintained on enoxaparin over DOAC ultimately under decision-making of Oncology. Sixty days later at cardiology follow-up, the decision was made to keep IVC filter permanently given incompletion of malignancy radiation therapy and high risk of further VTE.

Discussion

As RV failure and subsequent haemodynamic decline drive short-term mortality in PE, further risk-stratification is necessary. High-risk PE is currently characterized by haemodynamic instability: obstructive shock/hypotension defined as systolic blood pressure <90 mmHg or drop in systolic blood pressures > 40 mmHg for >15 min, or vasopressor requirement.[1,4] Patients without initial haemodynamic instability should be further risk assessed with PESI and sPESI along with troponin levels.

In this case, single-session thrombectomy resulted in reduction of pre-operative cardiopulmonary risk by alleviating the RV strain, allowing urgent cord decompression surgery to proceed with optimized haemodynamics and no further oxygen requirements. Current ESC guidelines recommend catheter-directed thrombectomy in high-risk patients with absolute or relative contraindications to thrombolytics with risk for clinical deterioration, or in patients that have failed thrombolytic therapy (IIa, C).[1,3–5] In this case, our patient had no thrombolytic contraindication. However, given known increased risk of intracranial bleed with systemic thrombolysis, along with the higher risk for intracranial complication given the nature of spinal surgery, it was collectively decided by PERT and neurosurgery team that systemic thrombolysis posed overall higher relative risk. Surgical embolectomy and catheter-directed thrombolysis remained options, but time to surgery was of the essence. Our patient's PESI = 131 and sPESI = 2, placing her in PESI Class V, or very high 30-day mortality risk > 10%.[1]

Though systemic thrombolytics is associated with improved outcomes in high risk PE, risk of intracranial haemorrhage bleeding is significantly increased.[4,6] Local infusion with catheter-directed thrombolysis, as well as catheter-directed mechanical thrombectomy

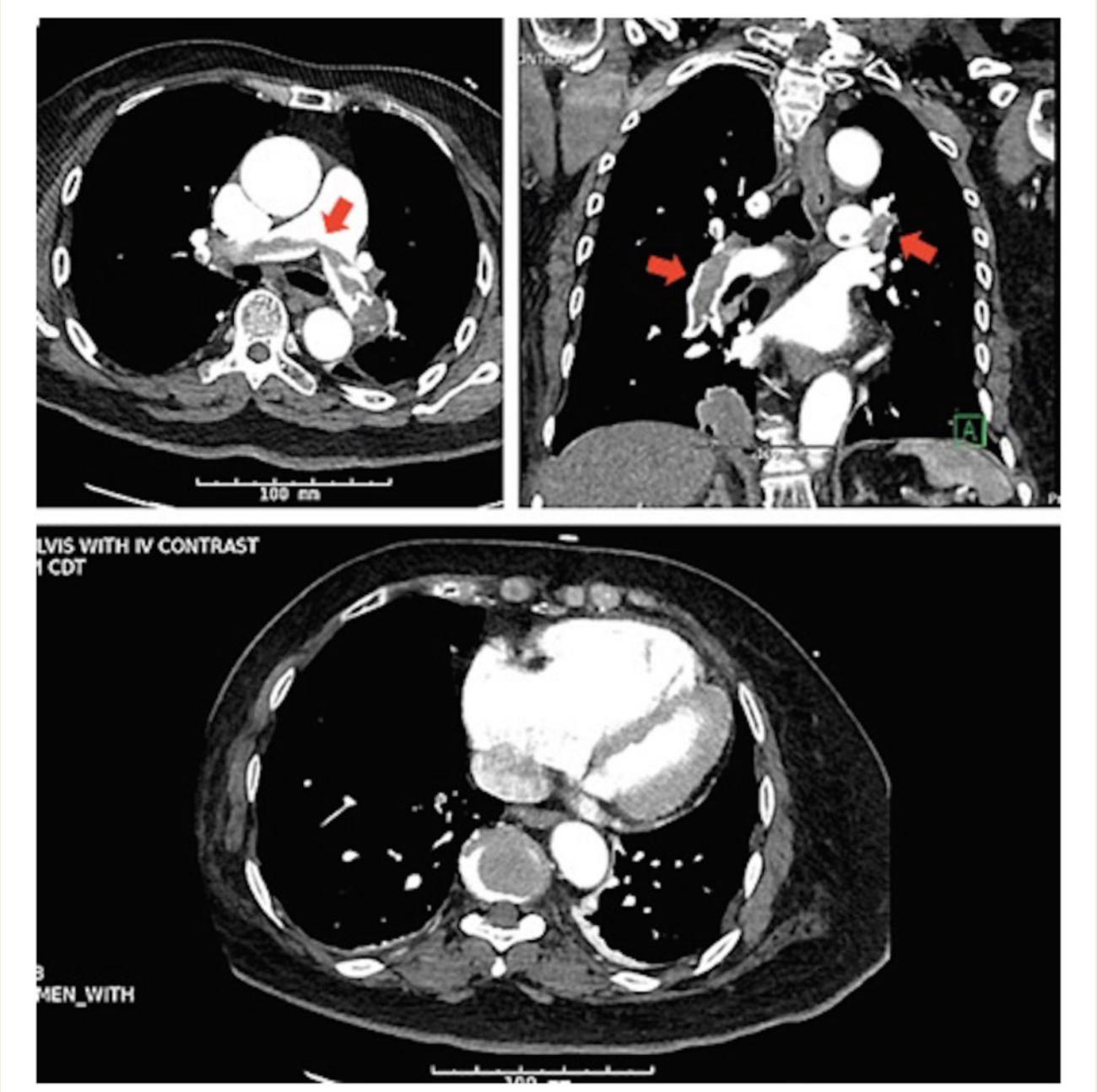

Figure 2 Computed tomography angiogram of the chest. Large saddle pulmonary embolus with extension to bilateral main, right and left pulmonary arteries in the axial and coronal views (red arrows). Axial cardiac view showed enlarged right ventricle with right ventricle/left ventricle ratio 2:1 signifying right heart strain.

have taken on a larger role in the past several years given favourable outcomes with significantly less bleeding complications than systemic thrombolysis.[7,8] In the recent FlowTriever Pulmonary Embolectomy Clinical Study (FLARE) of thrombectomy using the FlowTriever system in submassive/intermediate PE patients, major bleeding rate was 0.9% with no intracranial haemorrhage events,[2] demonstrating significantly decreased rate of bleeding compared to systemic thrombolysis. FLARE demonstrated significant reduction in RV/LV ratio at 48 h (1.53–1.15, $P < 0.0001$): an independent predictor of mortality from PE.

While peri-operative risk stratification for cardiovascular outcomes is well established, there are no clear guidelines for peri-operative risk stratification in the setting of pulmonary embolism. Thus, the importance of the multidisciplinary PERT team is emphasized in this case.[5]

Conclusion

Risk stratification and management of intermediate–high-risk pulmonary embolism in the setting of urgent surgery remains unclearly

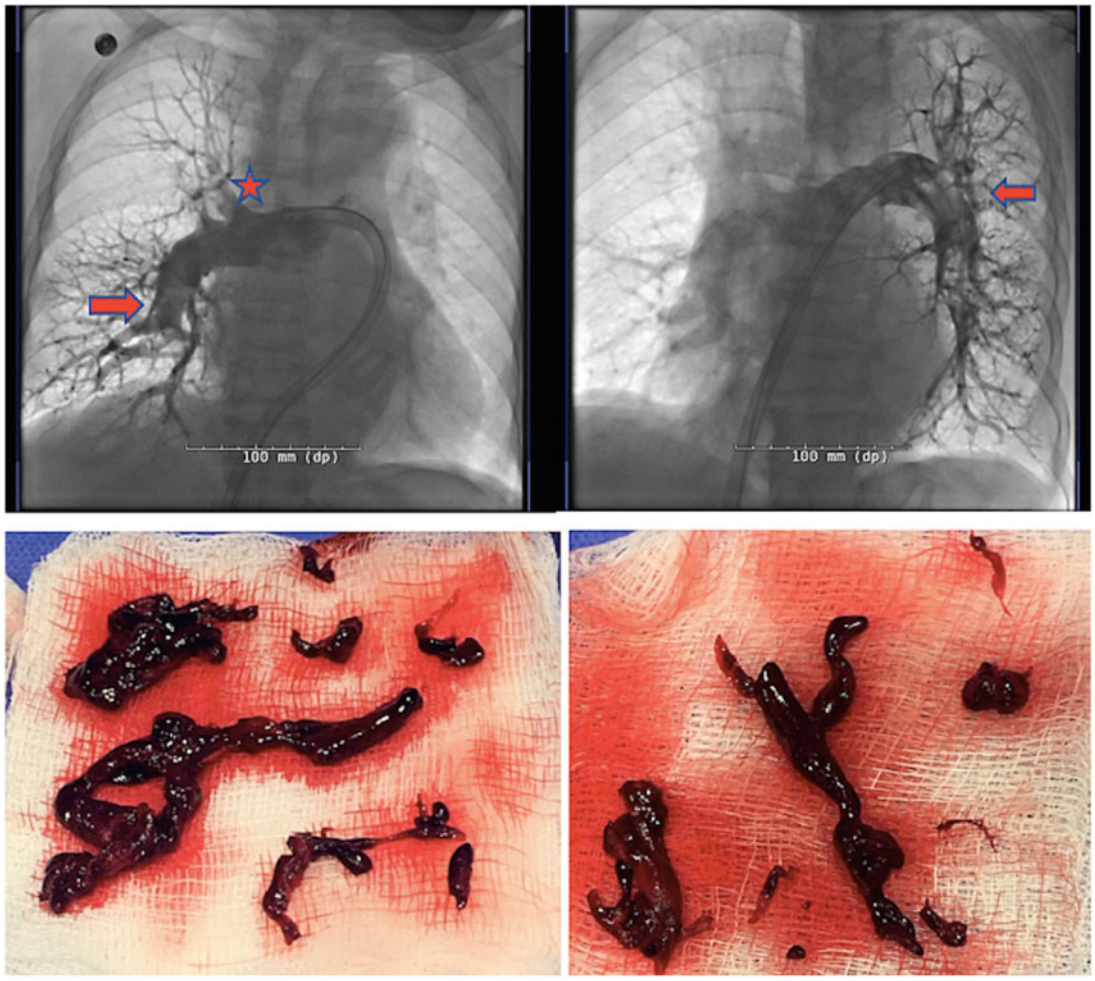

Figure 3 Post right pulmonary artery (RPA) and left pulmonary artery (LPA) thrombectomy angiogram with clot removed. Post-thrombectomy angiogram showed patency of the right interlobar artery (red arrow); minimal residual thrombus in truncus anterior (red star), and patency of the left pulmonary and interlobular arteries (red arrows). Large amount of clot was removed with no haemodynamic instability.

defined. This case highlights plausible advantages of mechanical thrombectomy over thrombolysis in the peri-operative setting in a patient with intermediate–high-risk PE needing urgent surgery.

Lead author biography

Isabel Planek, MD, is an Internal Medicine resident physician at Rush University Medical Center, Chicago, IL, USA. She completed her medical degree at Chicago Medical School in 2019 and undergraduate studies at the University of Notre Dame in 2015. Clinical and academic interests include preventive cardiology, cardio-oncology, and electrophysiology.

Supplementary material

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

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Slide sets: A fully edited slide set detailing these cases 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's guardians in line with COPE guidance. Informed consent was obtained from the patient

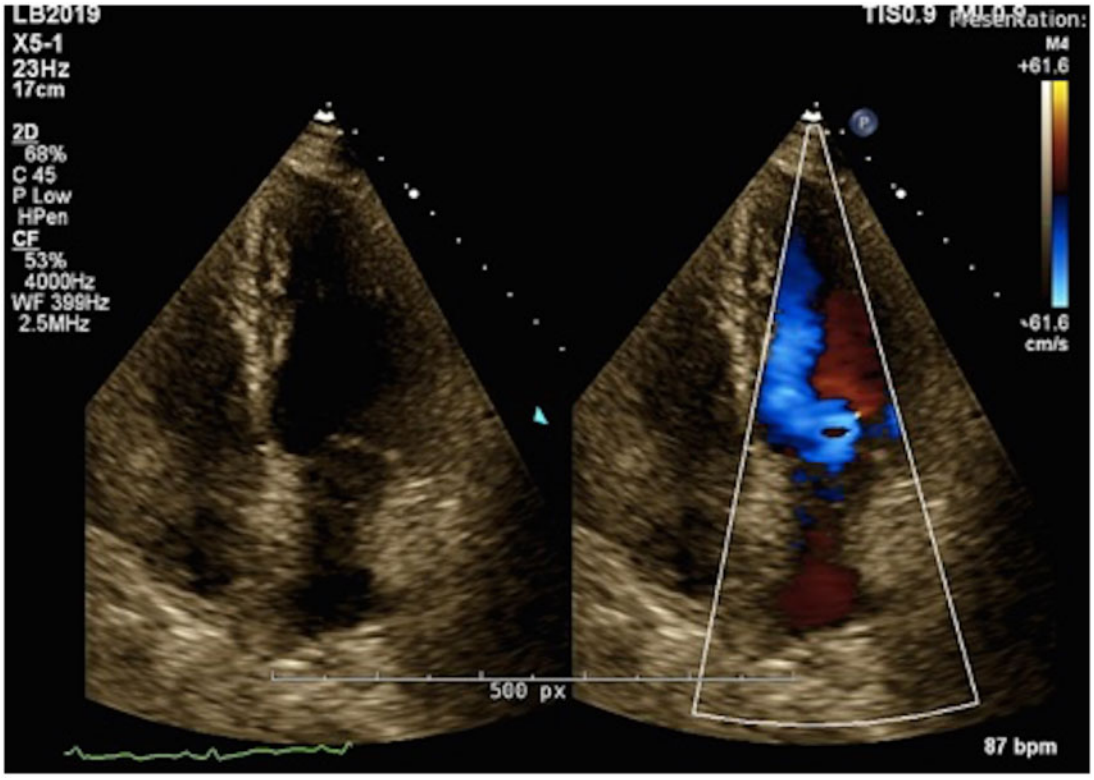

Figure 4 Follow-up transthoracic echocardiogram. Resolution of right ventricle with normal right ventricular systolic function.

with daughter as witness, using the *European Heart Journal – Case Reports* Consent Form.

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