

# Four-dimensional flow evaluation of left atrial myxoma-related mitral inflow

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## Case description

A 71-year-old woman with a history of endometrial cancer was referred for CMR imaging for precise assessment of left ventricular (LV) function after the surgical removal and pharmacological treatment of the tumour. The patient was asymptomatic. The CMR protocol included cines, T1 mapping, T2 mapping, first-pass perfusion, late gadolinium enhancement, and 4D flow imaging. The LV was normal in size (mass, 52 g/m<sup>2</sup>; indexed end-diastolic volume: 66 mL/m<sup>2</sup>) with preserved ejection fraction (60%). The left atrium had a mobile intracavitary mass (32 × 33 × 26 mm; AP × transverse × craniocaudal) with dynamic mitral valve stenosis. The mass was mildly heterogeneous and predominantly hyperintense on T2 short-inversion-time inversion-recovery and T1-weighted images.

On 4D flow two-dimensional vector visualization, during early and late filling, the blood flow accelerates through the anterior leaflet of the mitral valve. There was evidence of E/A flow reversal and absence of diastolic vortex formation (see [Supplementary material online, Video S1](#)). A diastolic LV vortex is formed in the low-pressure areas near the basal mitral annular area inside the LV. This doughnut-like vortex preserves the kinetic energy of blood flow during early and late filling (see [Supplementary material online, Video S2](#)). A lack of it would plausibly mean further loss of diastolic function and cardiac efficiency.

The absence of LV diastolic vortex formation has been linked with aging and other cardiovascular diseases. The patient had successful surgical removal and confirmed histological diagnosis of myxoma ([Figure 1](#)).

This case highlights the importance of not only multi-parametric tissue characterization by CMR to facilitate the diagnosis of myxoma but also the use of emerging 4D flow CMR visualization and quantification tools to allow enhanced assessment of transvalvular flow and associated flow-related patterns. However, more work must be done to develop our comprehensive understanding of how vortex formation is dependent on LV geometry, pressure gradients, and mitral annulus.

## Supplementary material

[Supplementary material](#) is available at *European Heart Journal – Case Reports*.

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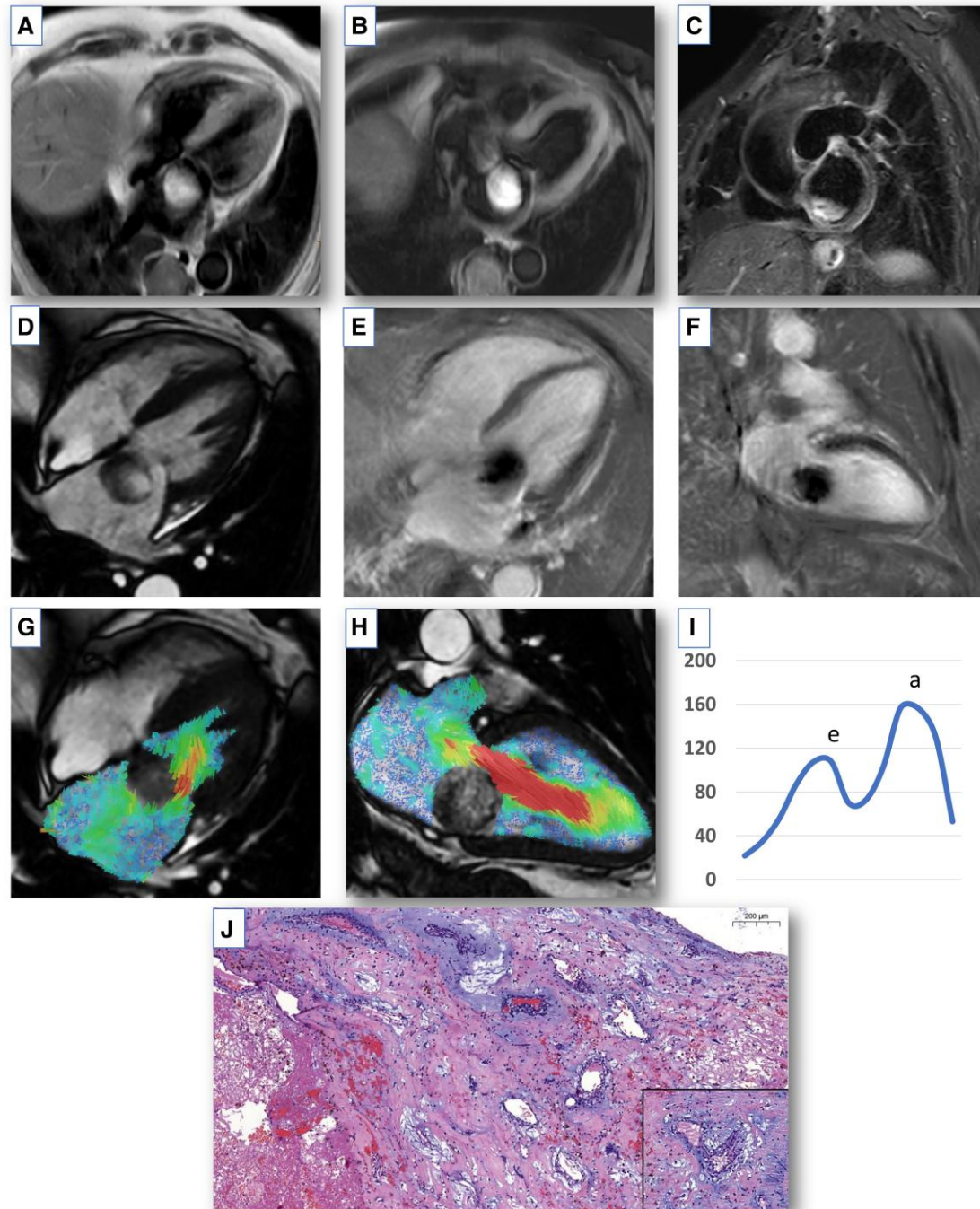
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**Figure 1** Multi-parametric cardiovascular magnetic resonance imaging of myxoma. (A) T1-weighted black pool turbo spin-echo sequences demonstrating a mildly heterogeneous and predominantly hyperintense mass in the left atrium. (B) T1-weighted turbo spin-echo with selective fat suppression sequence reveals a hyperintense intracavitary left atrial mass denoting no fat content. (C) T2 short-inversion-time inversion-recovery black pool mapping showing a hyperintense and mildly heterogeneous left atrial myxoma. (D) Four-chamber cine steady-state free precession cine image showing a mobile intracavitary mass measuring  $32 \times 33 \times 26$  mm in the left atrium with heterogeneous signal intensity. (E and F) Inversion recovery late gadolinium enhancement images with phase-sensitive reconstruction in four-chamber and two-chamber long-axis cine showing mildly heterogeneous hyperenhancement. (G and H) Four-dimensional flow streamline visualization of flow acceleration through the anterior leaflet of the mitral valve in four-chamber and two-chamber long-axis cine stack of images. (I) Peak mitral inflow velocity trace demonstrating peak E-wave (peak mitral inflow velocity in the left ventricle in early diastole) and A-wave (peak velocity of transmitral blood flow in late diastole due to atrial contraction) velocities. (J) Haematoxylin and eosin stain showing classic cardiac myxoma tumoural cells with the presence of a heterogeneous matrix of tumoural cells with myxoid background forming perivascular rings, mononuclear inflammatory infiltrates surrounding small intratumoral blood vessels, and areas of thrombosis and hemosiderin-loaded macrophages. There is no cytologic atypia or mitotic activity seen.

associated text, has been obtained from the patient in line with COPE guidance.

**Conflict of interest:** P.G. has a clinical advisor role with Medis Medical Imaging and Pie Medical Imaging.

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### Data availability

The data underlying this article are available in the article and in its on-line supplementary material.