Flow collision in early aortic ejection: an additional source of kinetic energy loss in patients with mitral prosthetic valves

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Echocardiographic left ventricular (LV) flow analysis was performed with vector flow mapping (VFM) in a 48-year-old asymptomatic patient with prior mitral valve replacement by bi-leaflet prosthesis in 2013.

Streamlines in Panel A show the consequence of trans-prosthetic mitral inflow directed towards the septum: the development of a dominant posterior vortex showing counter-clockwise (CCW) rotation (see Supplementary data online, Video S1). This flow distribution results in abrupt changes in flow direction towards the LV outflow tract at the initial phase of aortic ejection (Panel B). Panels C and D show an increase in energy loss in the sub-mitral region due to flow collision before its redirection towards the outflow tract, as indicated by the superimposed flow vectors kinetic energy variations. Panels E and F show the predominant anterior vortex redirecting flow towards the outflow tract in healthy subjects. Panels G and H show the low energy-dissipation ejection in normal subjects.

LV inflow generates rotational flow that organizes in vortices, with a dominant, clockwise-rotating, anterior component—as seen in apical long-axis view—in normal subjects. This vortex contributes to cardiac function through kinetic energy storage and a smooth redirection of flow towards the outflow tract. Patients with mitral prosthetic valves often show changes in inflow resulting in vortex rotation reversal, which has been reported to increase energy loss during diastole. In these images, we show additional kinetic energy loss during early systole due the absence of clockwise flow redirection, which causes flow collision against the mitral prosthesis and mitral-aortic junction before ejection.

Supplementary data are available at European Heart Journal — Cardiovascular Imaging online.

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