Marked three-dimensional flow pattern changes in distorted aortic geometry

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Functional cardiovascular magnetic resonance imaging (MRI) was performed in a 72-year-old female patient who underwent MRI to detect aortic high-risk plaques as a potential source of embolic stroke. Magnetic resonance imaging revealed an unusually complex aortic shape including kinking and elongation of the descending aorta (DAo). To analyse haemodynamic consequences of these geometric changes, time-resolved three-dimensional (3D) MR velocity mapping and visualization of the measured blood flow velocities using systolic 3D streamlines was performed.

The resulting image and video illustrate the intricate impact of the complex aortic shape on blood flow such as the physiologically expected acceleration of flow at bends (white arrow). Noticeably and despite normal lumen diameters (26–31 mm), the distorted route of the vascular lumen introduced marked vortical flow patterns in the ascending aorta (AAo) and proximal DAo (open arrows). Note that no aortic valve abnormalities (insufficiency or valve stenosis) were seen in echocardiography. These findings clearly differed from normal flow patterns such as a mild-to-moderate right-handed systolic outflow helix and mild early diastolic retrograde flow in the AAo and arch. Disturbed flow patterns such as regional helical and vortex flow are usually absent in the healthy thoracic aorta.

The marked distortion of the aortic shape and secondary flow patterns (vortices) was unexpected but had no immediate clinical consequences. Nevertheless, the findings indicate that regional geometric changes can impact haemodynamics even distantly from the site of the geometric distortions. Such haemodynamic changes may lead to altered strain at the aortic wall and result in secondary morphological alterations.

Supplementary material
Supplementary material is available at European Heart Journal online.
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