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CARDIOVASCULAR FLASHLIGHT

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Pre- and post-operative assessment of valvular and aortic flow using 4D flow magnetic resonance imaging

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Findings in a 71-year-old male patient are reported who presented with an aneurysm of the ascending aorta and a heavily calcified bicuspid aortic valve with severe stenosis and mild regurgitation. Transthoracic echocardiography and invasive assessment showed normal left ventricular function, a severely reduced valve area of 0.77 cm², and a dilation of the ascending aorta of 52 mm. To further investigate the haemodynamic influence of the valvular and aortic pathology, a pre- and post-operative assessment using time-resolved three-dimensional phase-contrast magnetic resonance imaging (4D Flow MRI) was performed using a 1.5T MR scanner (Philips Achieva, Best, The Netherlands). Blood flow analysis was performed using a prototype software package (GTFlow, GyroTools, Zurich, Switzerland). After the pre-operative 4D Flow MRI exam, the patient underwent replacement of the aortic root with a biological aortic valve prosthesis (25 mm, Medtronic Freestyle®) and of the ascending aorta, using a collagen-impregnated woven prosthesis (28 mm, Hemashield Woven®). A post-operative 4D Flow MRI scan was obtained 85 days after the operation. Panels 1A and B compare pathlines pre- and post-operation. While helical flow patterns are observed in the ascending aorta pre-operation (Panel 1A, Supplementary material online, Movie S1), normal flow patterns are found after the operation (Panel 1B, Supplementary material online, Movie S2). The distinct systolic retrograde flow channel (Panels 1C and E) observed pre-operation disappeared entirely after the operation (Panels 1D and F), indicating increased efficiency of blood transport. Likewise, systolic peak flow was significantly reduced after the operation (Panels 1E and F). In summary, this example demonstrates the value of 4D Flow MRI in assessing patients with valvular and aortic disease. The method holds potential for advanced pre-operative patient assessment and follow-up monitoring with particular emphasis on quantifying haemodynamic implications of structural alterations in a non-invasive and comprehensive manner.

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

