Interpretation of an aneurysm

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A 51-year-old female was referred to our institution for an accidentally found sinus of valsalva aneurysm (SVA). Multi-slice computer tomography and cardiovascular magnetic resonance imaging (CMR) well depicted a 76 × 43 mm right SVA sprawling over right ventricular outflow tract (Panel A). Aneurysm resection along with valvesparing aortic root replacement was performed (Panel B), and the follow-up CMR 1 month after surgery confirmed restoration of aortic root morphology and blood flow (Panels C and D; Supplementary material online, Video S1). Time-resolved three-dimensional phase contrast (4D flow) technique visualized dynamic 3D flow features of both the aneurysm and aorta. Flow velocity streamlines demonstrated an eccentric systolic flow jet branching from the main aortic outflow during early systole at the misshaped opening of right sinus of valsalva, directing blood towards the posterior wall of the aneurysm with a peak velocity of 1.5 m/s, and evolving into a left-handed downward vortex with a forward flow of 16 mL/cycle (Panels E–H). A resulting helix flow pattern was fully developed at the upper portion of the aneurysm during mid and late systole, and extended into diastolic phases as low-velocity swirls gradually filling the entire aneurysm (Supplementary material online, Video S2). The highly uneven flow distribution within the aneurysm provided unique vantage points to better understand the pathogenesis of its diverse complication spectrum including expansion, rupture, and thrombosis. Flow quantification revealed impairment in aortic flow and peak velocity via aberrant vortex redirected into the aneurysm, both of which markedly increased after surgery to the level of an age-, gender-, and BSA-matched health volunteer (Panels I and J).

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