Four-dimensional flow cardiovascular magnetic resonance for the evaluation of the atrial baffle after Mustard repair

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A 13-year-old boy with congenitally corrected transposition of the great arteries and mild Ebstein malformation underwent double-switch operation [atrial switch (Mustard) plus arterial switch procedure; Panel A] at the age of 8 years after prior pulmonary artery banding.

During routine follow-up, two-dimensional (2D) echocardiography showed a local narrowing in the inferior limb of the systemic venous baffle with aliasing on colour Doppler imaging (Panels B and C). Cardiac magnetic resonance examination, including four-dimensional flow MRI whole-heart velocity mapping (three-directional velocity encoding: 150 cm/s), was performed to assess intra-cardiac flow haemodynamics.

Particle tracing revealed an increased flow velocity at the level of the luminal narrowing similar to echocardiography (Panel D) with a clockwise circulating flow in the systemic venous atrium. Locally elevated peak systolic wall shear stress (WSS) on the anterior and posterolateral side of inferior baffle was observed (Panels E and F).

Furthermore, at the posterosuperior wall of the systemic venous atrium, a specific region with elevated WSS was noted (Panel F), which corresponds with the impingement of the outflow jet from the narrow inferior baffle limb. These findings represent moderate baffle obstruction, a common complication after Mustard operation.

Four-dimensional flow MRI confirmed observations from echocardiography and shows its clinical applicability for atrial baffle evaluation. This technique is not limited by body mass or poor acoustic penetration, is less operator-dependent, and allows blood flow quantification at any retrospective selected region of interest, which are clear advantages over echocardiography and 2D flow MR imaging. The presence of remarkable flow patterns and findings in WSS may provide further insights in the development of complications after atrial switch repair.

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Ao, ascending aorta; ILSVB, inferior limb of systemic venous baffle; IVC, inferior vena cava; LV, left ventricle; MPA, mean pulmonary artery; PVA, pulmonary venous atrium; RPA, right pulmonary artery; RV, right ventricle; SLSVB, superior limb of systemic venous baffle; SVA, systemic venous atrium; SVC, superior vena cava. *, inferior limb of systemic venous baffle; #, superior limb of systemic venous baffle.

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