

Abnormal blood flow pattern in the aorta and pulmonary trunk of patients with Transposition of the Great Arteries operated with Atrial Baffle Switch

Nordmeyer S., Messroghli D., Berger F., Kuehne T., Riesenkampff E.

Deutsches Herzzentrum Berlin, Department of Congenital Heart Disease/Pediatric Cardiology, Berlin, Germany

Background: Patients with transposition of the great arteries (TGA) after atrial baffle switch operation show differences in ventricular torsion and outflow tract geometry compared to healthy volunteers and TGA patients after arterial switch operation. We sought to investigate if these differences in cardio-mechanics translate into abnormal blood flow patterns in the pulmonary trunk and the aorta.

Methods: Blood flow patterns were assessed with flow-sensitive four-dimensional velocity-encoded magnetic resonance imaging (4D VEC MRI), using a 1.5T Phillips MRI system. Measurements were made in the pulmonary trunk and the aorta of TGA patients after atrial baffle switch operation (n=10) and compared to healthy volunteers (n=7) and TGA patients after arterial switch operation (n=7). Blood flow was analyzed for vortex formation and helical blood flow pattern using custom-made software.

Results: There were clear differences in blood flow patterns between TGA patients after atrial baffle switch operation and healthy volunteers and TGA patients after arterial switch operation in both the pulmonary trunk and the aorta. In healthy volunteers and TGA patients after arterial switch operation, flow was laminar, parabolic in the pulmonary trunk and showed left helical flow pattern in the aorta. In TGA patients after atrial baffle switch operation we observed opposite flow patterns with predominant parabolic flow in the aorta but helical flow and vortex formation in the pulmonary trunk. Helical blood flow pattern was present in the ascending aorta in healthy volunteers and patients after arterial switch and was less pronounced in patients after atrial baffle switch ($p < 0.05$).

The figure shows streamlines of the ascending aorta and pulmonary trunk in a healthy volunteer (A) and a representative patient with TGA after atrial baffle switch operation (B).

Conclusions: There are abnormal flow profiles in the aorta and pulmonary trunk in TGA patients after atrial baffle switch operation compared to healthy volunteers and TGA patients after arterial switch operation. The data of this study provide evidence that differences in left and right ventricular cardiomechanics directly translate into different flow patterns.

