

4D flow CMR and CT of the left ventricular outflow tract and neo-aorta after the arterial switch operation

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Introduction: Neo-aortic root dilatation, a common complication after the arterial switch operation (ASO) for transposition of the great arteries (TGA), could theoretically be related to the changed geometric and hemodynamic characteristics of the reconstructed left ventricular outflow tract (LVOT) after ASO. The aim of this study was to determine if geometric characteristics of the LVOT and related blood flow patterns are associated with neo-aortic root dilatation by using four-dimensional (4D) flow cardiovascular magnetic resonance (CMR) and cardiovascular computed tomography (CCT).

Methods: The study cohort consisted of 59 TGA patients who underwent ASO between 1978 and 2001. The following neo-aortic root measurements were performed using CCT: (1) surface area of aortic valve annulus indexed by Z-score, (2) surface area at level of aortic root sinuses indexed by Z-score and (3) spatial relationship between aortic root and pulmonary trunk in the transverse plane. (4D flow) CMR was used to assess (4) the geometric relationship between LV and ascending aorta, expressed by 4 angles between the LV and LVOT as seen in Figure 1 and (5) degree of flow eccentricity by measuring the angle between peak systolic flow direction and aortic valve annulus. Correlations were determined using Pearson's correlation coefficient.

Results: Neo-aortic root dimensions were increased (mean±SD for Z annulus: 2.98±1.60, Z sinus: 2.43±1.41). Neo-aortic root dimensions were not correlated with any of the four angles as described (4) ($r < 0.06$, $p > 0.05$), nor to the spatial relationship between aortic root and pulmonary trunk (3) ($r = -0.20$, $p = 0.14$) or flow eccentricity (5) ($r = 0.04$, $p = 0.79$). Patients with pre-operative ventricular septal defect (VSD) ($n = 16$, 27%) had similar aortic root dimensions as patients without and the presence of pre-operative VSD was not associated with aortic root dilatation. ASO patients had good ventricular systolic function (mean LVEF 56.8% (95% CI[55.3, 58.3])).

Conclusions: Neo-aortic root dilatation in TGA patients is not related to the geometric characteristics of the LVOT after ASO, nor to the pre-operative presence of a VSD. Neo-aortic root dilatation is likely to be explained by other factors like abnormal aorticopulmonary septation and surgical manipulations.

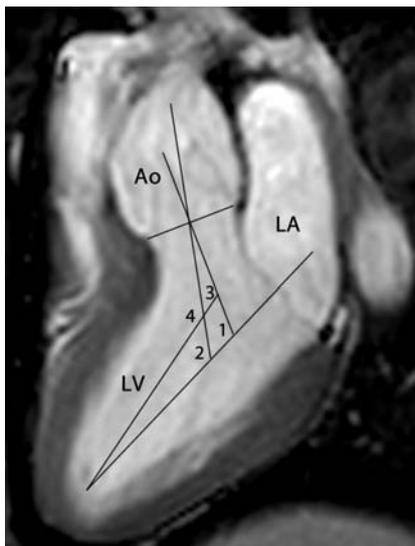


Figure 1. CMR image of a 3 chamber LV view during systole with (1) angle between LV inflow (line bisecting mitral valve annulus to LV apex, based on expected intracardiac blood flow) and line perpendicular to aortic valve annulus; (2) angle between LV inflow and aortic root long axis (line bisecting aortic valve annulus); (3) angle between LV intracardiac outflow during systole (based on expected intracardiac blood flow) and line perpendicular to aortic valve annulus; (4) angle between intracardiac outflow during systole and aortic root long axis. Ao, aorta; LA, left atrium; LV, left ventricle.