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Poster presentation

Impairment of aortic elastic properties in patients with transposition of the great arteries post arterial switch operation

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Introduction

The arterial switch operation (ASO) is now the standard of care for palliation of dextro transposition of the great arteries (d-TGA). The status of the transposed aorta (Ao) is considered an important determinant for long-term prognosis.

Purpose

To assess the bioelastic properties of the thoracic Ao through measurement of distensibility and pulse wave velocity (PWV), and to identify risk factors associated with reduced aortic elasticity.

Methods

Fourty-two d-TGA patients (median 15, range 0.5-31.0 years) were examined with 3.0 T MRI. 26 patients had simple transposition and 16 patients had additional risk factors (ventricular septal defect (VSD) n = 7, aortic coarctation n = 3, prior pulmonary artery banding n = 5, and ASO without Lecompte maneuver n = 1). 34 heart healthy subjects were enrolled as controls (median 11.4, range 2.3-31.3 years).

Gradient-echo cine MRI (FOV 280 × 224 mm, voxel size 1.88 × 1.94 × 6 mm, TR = 4.4 ms, TE = 2.5 ms, flip angle: 15°) was used to determine aortic distensibility at three levels (ascending, proximal and distal descending Ao) with the following formula: (Amax - Amin)/[Amin × (Pmax - Pmin)]; A = cross-sectional aortic lumen area, P = blood pressure. Phase contrast MRI flow measurements (FOV 270 × 270 mm, voxel size 1.64 × 1.4 × 7 mm, TR = 4.4 ms, TE = 2.7 ms, velocity encoding (VENC) = 200 cm/s) in the ascending and descending Ao served to assess regurgitant fraction (RGF) of the aortic valve and PWV, calculated as the ratio of the distance between the ascending and descending Ao and the time delay of the systolic velocity up-stroke between proximal and distal locations.

Results

Distensibility of the ascending ($3.9 \pm 2.9\ 10^{-3}$ $mmHg^{-1}$ vs $10.8 \pm 5.5\ 10^{-3}$ $mmHg^{-1}$, $p < 0.01$) and proximal descending Ao (7.1 ± 3.0 vs 9.0 ± 5.1, $p < 0.01$) was significantly reduced in d-TGA compared with controls. A larger cross-sectional area of the Ao was associated with a reduced distensibility of the ascending Ao ($r = -0.4$, $p < 0.05$) and an increased RGF ($r = 0.47$, $p < 0.01$). PWV was not significantly different in d-TGA and controls (3.8 ± 1.4 m/s vs 3.3 ± 0.5 m/s; $p = 0.8$). Patients with risk factors had a significantly reduced distensibility of the ascending Ao as compared to simple d-TGA ($4.9 \pm 3.3\ 10^{-3}$ $mmHg^{-1}$ vs $2.5 \pm 1.2\ 10^{-3}$ $mmHg^{-1}$, $p < 0.05$).

Conclusion

During long-term follow-up the distensibility of the ascending and descending Ao is reduced in d-TGA patients post ASO compared to normals. A larger cross-sectional diameter of the ascending Ao is associated with Ao valve insufficiency and reduced distensibility. Within d-TGA patients those individuals with additional risk factors show more severly impaired elasticity of the ascending Ao, and should therefore have close CMR follow-ups.