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Flow pattern and vascular distensibility of the pulmonary arteries in patients after repair of tetralogy of Fallot. Insights from 4D flow CMR.

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Objectives: Pulmonary regurgitation is common after repair of tetralogy of Fallot (TOF). The regurgitant flow may lead to changes in flow profile, size and distensibility of the pulmonary arteries (Pas).
We sought to assess Pa flow and distensibility in TOF patients (pts) by cardiac magnetic resonance (CMR) and to correlate them with flow patterns provided by 4D flow CMR.
Methods: 18 TOF pts (mean age 28±11yrs, weight 63±12 kg) and 9 controls (age 17±7yrs, weight 63±24kg) underwent CMR. 2D Phase-contrast (PC) images were acquired through-plane in the main (MPA), right (RPA) and left pulmonary artery (LPA). A 4D PC dataset was acquired covering all great arteries. Vessel areas and quantitative flow were measured on the 2D PC images. Flow patterns in Pas were qualitatively assessed for presence of helix or vortex on the reconstructed 4D images. Flow parameters, size and distensibility of the Pas were compared between TOF pts and controls and in the TOF group between RPA and LPA with regard to helix/vortex.
Results: In TOF pts, MPA mean regurgitant fraction (RF) was 25±17%. Compared to controls, both Pas were larger and distensibility was higher in LPA. RF was greater in LPA than in RPA (p 0.001) and LPA was larger than RPA (p 0.0342). Net flow was lower in LPA than in RPA (p 0.0005). Distensibility was similar in LPA and RPA and correlated with RF, regurgitant flow and minimum area. Vortex was observed in LPA in 72% of TOF pts, but not in normals. Helix was present in 44% of pts and in 11% of normals and was correlated with higher distensibility (p 0.04). Presence of vortex was independent from any other parameter.
RPA presented helix in 77% of pts and in 55% of controls. Vortex was only detected in 11% of TOF pts.
Conclusion: After TOF repair, Pas size and distensibility are mainly determined by the amount of regurgitant flow and less by flow patterns, such as vortex or helix. Characteristic flow patterns are found in LPA and RPA, which seem to be more related to the geometry of the pas than to quantitative flow parameters.