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Non contrast 3D steady-state free-precession magnetic resonance angiography: the more relevant magnetic resonance technique for the assessment prior to Ross procedure?

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Background : Accurate evaluation of the native aortic annulus or left ventricular outflow tract (LVOT) dimensions is critical for planning aortic root interventions. We use cardiovascular magnetic resonance (CMR) for assessment of the aortic root dimensions prior to the Ross procedure. Non-contrast 3D steady-state free-precession magnetic resonance angiography (3D-SSFP MRA) with electrocardiographic and respiratory gating is a safe and accurate technique to evaluate the entire aorta.

Purpose: 1) To determine the agreement between two CMR measurements (3D-SSFP MRA and cine SSFP) and direct in-vivo measurement of the aortic annulus, 2) To evaluate the ability of preoperative CMR to predict the need for aortic annuloplasty.

Methods: We retrospectively included patients who had a comprehensive CMR exam as preoperative assessment for a Ross procedure and intraoperative aortic annulus diameter measurement using Hegar dilators. CMR exams (1.5T scanner) were performed using a dedicated protocol including orthogonal long-axis LVOT cine-CMR images, double-oblique short-axis LVOT cine images planned from these views and a 3D-SSFP MRA covering the LVOT and thoracic aorta. Considering the elliptical shape of the aortic annulus, minimal and maximal aortic annulus (LVOT) diameters were measured and averaged in long-axis cine-CMR, in short-axis cine-CMR and from multiplanar reconstructed 3D-SSFP MRA images (Figure, left panel). Agreement between CMR and in-vivo aortic annulus measurements was assessed by Bland-Altman analysis.

Results: We identified 44 patients (mean age 40.5 [23-62] years, 21 females, 29 aortic stenoses, 5 aortic regurgitations, 10 mixed aortic diseases, 25 aortic aneurysms) with complete records. All patients had a congenitally abnormal aortic valve (19 unicusp, 24 bicuspid, 1 quadricuspid aortic valves). Close agreement was observed between minimal 3D-SSFP MRA LVOT diameter and in-vivo aortic annulus diameter (bias -0.7 95%CI -1.2 to -0.2 mm; limits of agreement (LoA) -4.20 to 2.75 mm, Figure middle panel) and between mean 3D-SSFP MRA LVOT diameter and in-vivo aortic annulus diameter (2.1, 1.6 to 2.6 mm; LoA -1.07 to 5.31 mm). Minimal 3D-SSFP MRA LVOT diameter best predicted the need for aortic annuloplasty (area under the curve 0.88, 95% CI 0.87-0.91, Figure right panel).

Conclusion: Mean and minimal 3D-SSFP MRA LVOT diameters best agree with the aortic annulus diameter measured in-vivo. Minimal 3D-SSFP LVOT diameter may be the more relevant measurement for planning aortic annuloplasty as part of a Ross procedure. CMR aortic annulus or LVOT measurements should be obtained from multiplanar reconstruction of gated 3D datasets.
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