**Study Specific SOP**

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| **Title:** | Cardiac magnetic resonance imaging (CMR), EPOCH-ASO | |
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# Purpose

The purpose of this SOP is to describe the standards for image acquisition, image analysis and reporting of cardiac mangnetic resonance tomography for assessment of cardiac anatomy and function as part of the EPOCH-ASO study.

# Scope / objectives

The SOP is valid for all clinical research functions participating at EPOCH-ASO study and aims to improve the comparability of CMR exams performed at different investigating sites. The SOP shall set a common standard for image acquisition, image analysis and reporting of results. The CMR protocol is in compliance with GCP, other SOP and regulatory requirement(s).

The general objectives of the standardized CMR-protocols part of the EPOCH-ASO study are:

1. To describe the standards for CMR examinations in adults with TGA after ASO as part of the EPOCH-ASO study
2. To improve comparability among examinations performed at different centers by different operators.
3. To detect and quantify aortic dilatation and regurgitation
4. To detect, localize and quantify right ventricular outflow tract obstructions and to evaluate pulmonary branches anatomy.
5. To detect myocardial fibrosis and ventricular dysfunction
6. To study the aortic arch

# Abbreviations

|  |  |
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| CMR | Cardiac magnetic resonance imaging |
| LGA | Late gadolinium enhancement |

# Procedure

## Study preparations / requirements

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| **Responsibility** | **Procedure** |
| Radiologist / cardiologist | * Blood pressure at the time of examination * Measure patient height and weight * Hematocrit for those who performe T1-mapping and ECV |

## Performing study

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|  | **Procedure** *(in brackets: estimated time for image acquisition)* |
| **Mandatory** | 1. Three-plane localizing images (3 Min.) 2. ECG-gated cine SSFP imaging of the ventricles *(10-12 min)*   a short axis stack covering both ventricles from base to apex (slice thickness 8 mm, no slice gap, in-plane resolution 1.3-1.7 mm2, 25 cardiac phases)   * three-, four- and two-chamber planes, * LVOT long-axis plane * RV outflow tract long-axis plane and double oblique RVOT plane.  1. ECG-gated cine SSFP imaging stack in short axis to the neoaortic root (slice thickness 5 mm, no slice gap). *( 2-3min)* 2. ECG gated cine SSFP imaging stack in an axial plane to image the branch pulmonary arteries (slice thickness 8 mm, slice gap 2 mm) with extending the stack to the ascending aorta (above the surgical suture) in order to image the descending aorta on the same plane (aortic distensibility)  * ECG-gated cine LPA and RPA *(2 min)* * perpendicular long axis (planned from the transaxial view) * double oblique perpendicular planned from the previous LPA/RPA long axis cine  1. Gadolinium contrast-enhanced 3D angiography *(2-3min)*   timing focused on:   * pulmonary arteries * second run for aortic arch and descending aorta  1. ECG-triggered (at end-diastole) and respiratory navigator gated 3D CA imaging (voxel size 1.5x1.5x1.5 mm) (*4-5min)*   *Optional (CT coronary angiography comparisons): best planned para-sagittal / para-aortal to capture end-diastolic neo-aortic root and coronary arteries (appr. 90 slice per slap)*   1. ECG-gated velocity-encoded cine for measurements in the main, left, and right pulmonary arteries, and ascending aorta *(3-4min)*  * velocity adjustments according to highest velocity (aorta 150cm/s, MPA/PRA/LPA >150cm/s); * *Optional: confirmation of ascending aorta flow can be performed by comparing it with the sum of the SVC and descending aorta flows (with 90cm/s).*  1. ECG gated LGE imaging in ventricular long- and short-axis planes (slice thickness 8 mm, no slice gap, in-plane resolution 1.3-2.0 mm2, end-diastolic phase) *(8-10 min)* |
| **Optional** | It requires additional software or experience and may thus be not available at all institutions:   1. T1-map of 1 short axis slice (copy image position of a SAX cine at the boarder basal to midventricular). *(0.5 min)* 2. Post-contrast T1-map of 1 short axis slice (copy image position of the same cine slice as pre-contrast, point 3 with same FOV and image position). *(0.5 min)* 3. \*A vasodilator stress protocol at baseline *(6-7min)* 4. \*4D-Flow: PC-VIPR sequence, retrospective ECG-gating, free-breathing. VENC 200 cm/s. FOV 400x400x400, isotropicvoxel 2.5x2.5x2.5 mm3, flipangle 8º, temporal resolution *(15-45 sec)*   \*To be acquired only in the baseline MR examination |

## Results / Report

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| **Responsibility** | **Procedure** |
| CMR specialists |  |
| Mandatory | CMR reports should comprehensively address the most common postoperative sequelae and include the following information:   * LV and RV volume, EF, mass, and regional function * Presence of focus of myocardial fibrosis and ischemic/embolic scars. If applicable, diffusse myocardial fibrosis and ECV * Extent of (LV) and RV outflow tract obstruction * Extent of pulmonary artery obstruction and calculation of the branch pulmonary artery flow distribution * Neoaortic root size and quantitation of neoaortic valve regurgitation (regurgitant volumen and fraction) * Aortic arch morphology, extent and severity of vascular stenosis * Presence of residual atrial septal defects and VSDs, and calculation of the pulmonary-to-systemic flow ratio (Qp/Qs) |
| **Optional** | * Quantitation of significant AV or neopulmonary valve regurgitation (regurgitant fraction and volume) * If applicable, description of the CA origins, proximal course, and degree of obstruction (CT examination as gold standard) * Presence and quantitation of aortopulmonary collateral vessels flow. * Aortic distensibility (used for research purpose) |