Coronary Veins Imaging Using Free-Breathing Whole-Heart 3D Cardiac Magnetic Resonance Imaging (MRI) at 3.0 Tesla: a Comparative study with Multi-Detector Computed Tomography (MDCT)

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Introduction

Recent studies show the feasibility of MDCT for assessment of coronary veins; however, it exposes patients to risk of use of ionizing radiation and potentially-nephrotoxic iodinated contrast agent. Alternatively, cardiac MRI at 3T has become a powerful tool for non-invasive evaluation of cardiovascular structures especially coronary arteries, with a potential ability to depict coronary veins since they are closely related and enhance with contrast administration. The purpose of this study is to evaluate the feasibility of 3T MRI to assess anatomy of coronary veins, and compare MRI measurements with those of MDCT.

Materials and Methods

A total of 42 consecutive patients (26 men, 19-71 year-old) were included in this study. Whole-heart contrast-enhanced MRI was acquired using a segmented k-space gradient echo; with inversion recovery (IR) prepared technique. Each subjects received up to a dose of 0.3 mmol/kg of gadolinium based contrast agent. Scan parameters were as follows: TR= 4.4ms, TE=1.5ms, α=20°, TFE factor=34, SENSE factor = 2, and voxel size 1x1x2 mm^3. Cardiac MDCT scan was performed with injection of 130 ml of nonionic iodinated contrast (5ml/sec). Images from MRI and MDCT were reconstructed at the most quiescent interval in the diastolic resting period of the cardiac cycle, and analyzed using the same commercially available software.

Results

All patients tolerated both MRI and MDCT without complications. The mean score of image quality was 3.75±0.5 for MRI, and 3.80±0.5 for MDCT, P = Not significant). Coronary sinus (CS), great cardiac vein (GCV), and posterior interventricular vein (PIV) were visualized in all patients by both modalities. Regression analysis demonstrates close relationship between ostial diameters of veins measured by MRI and MDCT, e.g. CS, GCV, PIV, anterior, posterior, and marginal veins (R^2= 0.99, 0.98, 0.98, 0.91, 0.93, 0.92 respectively). Also, various distances between CS and its tributaries were significantly correlated between both modalities. Also, veins length and CS-tributaries distance were significantly correlated between both modalities.

Conclusion

Free-breathing whole-heart 3D technique at high field MRI (3T) is a feasible technique, providing high spatial resolution images and homogenous myocardial suppression. This allows for clear assessment and measurement of coronary veins, with comparable results with high resolution MDCT imaging, but with better safety profile.

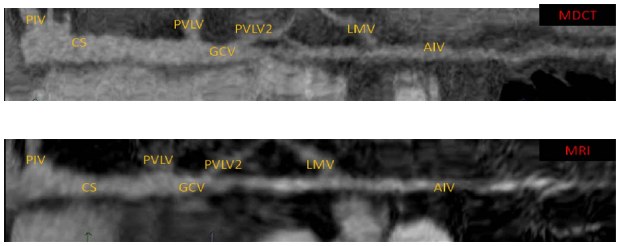

Figure 1. Stretched-out MPR coronary vein image by MDCT and MRI.

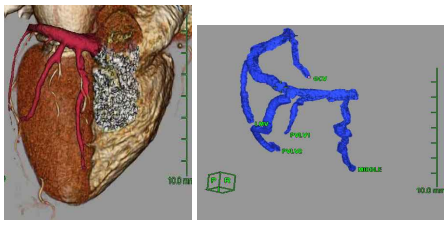

Figure 2. Volume rendering reconstruction of the coronary veins by A) MDCT (left) B) MRI (right)

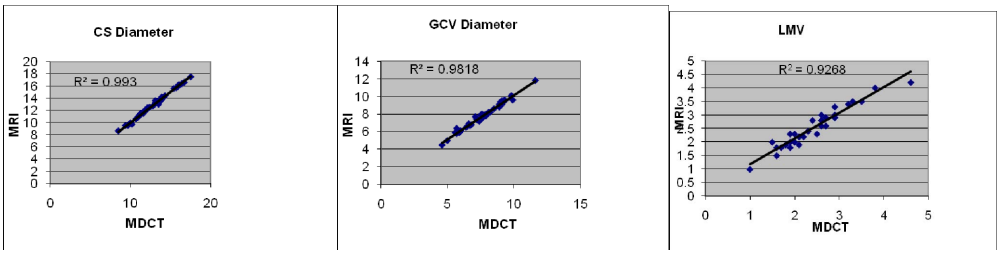

Figure 3. Demonstration of Regression analyses that show the close relationship between measurements of ostial diameters of CS, GCV, and LMV obtained using MRI and MDCT.