Coronary Vein Imaging is Optimal During the Systolic Rest Period in CRT Patients

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Objective

To quantify periods of low motion and cross-sectional area changes of the coronary veins during the cardiac cycle for planning magnetic resonance coronary venograms (MRCV).

Background

Three-dimensional, whole-heart, navigator-gated, contrast-enhanced MRI techniques are used to acquire cMRVs which can be used for planning lead placement in cardiac resynchronization therapy (CRT). In order to reduce cardiac motion artifacts, it is desirable to set the trigger delay time to acquire image data only during periods of low vessel motion, typically assumed to be during diastole. By knowing the duration and location of the low motion period, the acquisition window can be optimized for coronary vein imaging. Previous studies have examined coronary *artery* motion, but an analysis of the coronary *veins* has not been performed.

Methods

Nineteen patients with coronary artery disease (CAD) and 13 patients scheduled for CRT (EF<35%; QRS > 120 ms) were studied. Cine two-chamber vertical long-axis SSFP Images were acquired for all patients with at least 30 frames over the cardiac cycle using a 1.5T Siemens Avanto or Philips Intera scanner.

The displacement and cross-sectional area of the coronary sinus were tracked over the cardiac cycle. Rest periods were determined using a modified Euclidean Distance Quality Threshold clustering algorithm. Consecutive time points during which the position of the coronary sinus remained within a pre-specified region were binned together. The maximum allowable diameter of this region (quality threshold) was chosen to be 0.65 mm, the pixel dimensions of our 3D whole-heart coronary vein scan.

Patients were classified as *systolic dominant* or *diastolic dominant* based on whether the longest rest period was located in systole or diastole.

Results

All CRT patients and 6/19 CAD patients (all with ejection fraction <35%) were classified as systolic dominant. Six (32%) of the systolic dominant patients actually had no separate diastolic rest period. Thirteen CAD patients (all with ejection fraction >35%) were classified as diastolic dominant.

In 77% of all subjects, the cross-sectional area of the coronary sinus was larger in systole than in diastole.

Discussion

The combination of larger vessel areas during systole, the lack of a diastolic rest period in many CRT patients, and the fact that all of the CRT patients had longer systolic low motion periods suggest that systolic imaging would be preferable in obtaining MRCV in pre-CRT patients. Increased cross-sectional areas during systole may improve visualization of the vessel due to its larger size.

Ejection fraction was shown to determine whether a patient was systolic or diastolic dominant regardless of QRS duration (Figure 1).

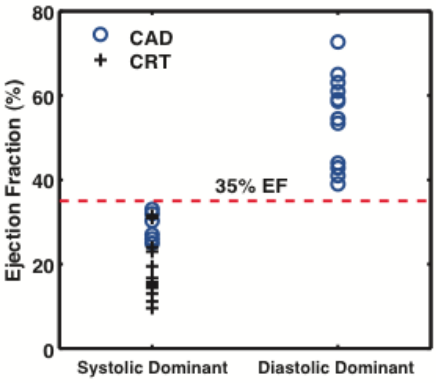

Figure 1. Ejection fractions for systolic and diastolic dominant patients.

Conclusion

The movement of the coronary sinus can be used to classify patients as either systolic dominant or diastolic dominant. Although this study suggests that systole is the ideal time to image coronary veins in pre-CRT patients (because of their low ejection fraction), each patient's low motion periods should be categorized to ensure the correct period is being utilized to minimize motion artifacts.