

Meeting abstract

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I 129 Image-guided placement of ECG leads to improve ECG gating in cardiac MRI

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Introduction

CMR is a noninvasive means of studying the heart without exposing the patient to ionizing radiation. A prerequisite to high-resolution CMR is effective cardiac gating. Although alternative techniques such as air-filled plethysmograph gating, laser-Doppler capillary gating, and self-gated imaging have been employed, the most common commercially available technique relies on ECG gating. In a subset of patients, the standard technique for ECG lead placement may be suboptimal secondary to patient factors such as abnormal cardiothoracic anatomy, obesity, or eventration of the hemidiaphragm. For such patients, a systematic time-efficient approach to optimizing ECG lead placement may improve image quality.

Purpose

To develop a time-efficient image-based technique with commercially available pulse sequences to guide lead placement and maximize R wave registration for CMR gating.

Methods

We prospectively studied 29 consecutive adult patients undergoing CMR. Imaging was performed on a 1.5 T Avanto magnet (Siemens, Erlangen, Germany). The ECG leads were initially positioned according to vendor guidelines. A vitamin E marker was placed on each lead to allow visualization on a T1-weighted breathhold 3D gradient echo pulse sequence. Multiplanar 3D reconstruction was performed to visualize lead placement relative to the

patient's heart. Measurements were performed to move the leads as follows: left leg lead (LL) to the apex of the left ventricle and right arm lead (RA) to the superior aspect of the right atrium. To place the right leg lead (RL), a straight line was measured from the RA lead to the LL lead. These two leads were moved and the distance between them measured. This distance was bisected and a perpendicular line projected inferiorly at a 90 degree angle. The RL lead was placed on this perpendicular line at a distance equal to half the original line's measurement (between RA and LL). The pre- and post-correction ECG tracings were qualitatively assessed by two blinded CMR physicians (one cardiologist and one radiologist). They ranked the two tracings in qualitative order as better, worse, or unchanged.

Results

Using the technique described, the ECG tracings were judged significantly improved in the majority of cases. The cardiologist's qualitative assessment of the 29 ECGs were as follows: 20 were improved, 6 showed no appreciable difference, and 3 were qualitatively better prior to movement. The radiologist's assessment of the 29 ECGs were as follows: 24 were improved, 3 demonstrated no appreciable difference, and 2 were qualitatively better prior to movement.

Conclusion

We describe a new technique that qualitatively improves the ECG tracing in the majority of CMR studies. While this

technique may not be needed on every CMR study, it may allow problematic studies to achieve proper gating. Using pulse sequences readily available on clinical MRI scanners, this procedure provides a reliable technique to improve ECG tracings on patients requiring such a correction.

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