

Moving Dipole Determination from 12-Lead ECGs Can Improve Detection of Acute Myocardial Ischemia

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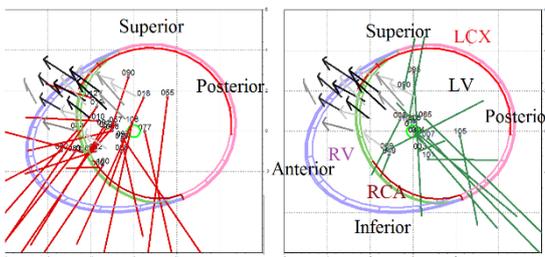
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We studied changes in moving dipole (MD) properties (location, orientation, and strength) during elective occlusion of a selected coronary artery. We explored whether MD changes caused by altered repolarization can provide information about the location of the pathological process. To do that, we used our method for the determination of MDs from 12-lead ECGs based on a spherically bounded model with a homogeneous volume conductor (CinC 2017).

We tested the hypothesis using the STAFF database with 103 cases of patients who underwent an elective coronary artery occlusion (proximal, mid-, and distal RCA or LCX or LDA occlusion). We identified parts of the ECG signal with signs of occlusion (e.g., ST-segment elevation) and extracted 20 s long signal specimens (after 1, 3, and 5 minutes of the occlusion) to construct the template beats from which we assessed MD properties. Specifically, we related the location of MDs of the ST-segment (ST-MD) to that of apparently healthy humans from our earlier studies.

To associate MD locations with the heart segments, we assumed that each heart follows the mean heart orientation within the thorax obtained from the MRI studies. We used to construct an appropriately oriented bi-ellipsoidal heart with the left (LV) and right (RV) ventricle. Finally, we displaced all MDs of a given template beat so that the mean location of MDs from the first half of QRS coincided with the center of the LV.

We found that during RCA or LCX occlusions, the ST-MDs moved from their initial location (close to the mid-anterior septum) along the septum and towards the inferior or posterior wall depending on the culprit artery with MDs oriented nearly perpendicularly to the LV wall. Besides, the ST-MD locations weren't affected significantly by the ECG ST-elevation magnitude until below 0.1 mV, thus aiding the detection of the inferior wall myocardial ischemia.



ST-MDs in the cross-section of the heart during proximal RCA (left, red arrows) and proximal LCX (right, green arrows). Numbers denote particular cases, black arrows represent the MD distribution in apparently healthy humans;