Coefficients for the Derivation of an ST Monitoring Patch Based Lead System from the 12 Lead Electrocardiogram

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Background: The 12-lead ECG is the current diagnostic standard in the detection of myocardial infarction (MI), however, it lacks sensitivity. Patch-based lead systems have been shown to complement the 12-lead ECG in the detection of cardiac abnormalities. There are limited datasets available to facilitate the evaluation of patch-based lead systems, so the leads must be derived from existing data. We have previously introduced a short spaced lead (SSL) system with the largest ST segment changes during ischaemic-type episodes. This two-lead system has a convenient patch-based format with electrodes spaced less than 100 mm apart and serves as the basis of this work. In this study, we aim to evaluate the derivation of a patch-based lead system from the 12-lead ECG.

Method: Thoracic body surface potential maps (BSPM) were recorded from n=734 patients. Recordings were taken from patients with myocardial infarction (n=271), left-ventricular hypertrophy (n=237) and healthy controls (n=226). Using Laplacian interpolation, each recording was expanded to the 352-node Dalhousie torso. Data were split into training (80%, n=587) and test (20%, n=147) datasets. The eight independent channels of the 12-lead ECG were extracted (I, II, V1-V6). The two leads of the SSL patch were extracted: an ST monitoring lead and a spatially orthogonal lead. Coefficients were derived using linear regression from the 12-lead ECG to the SSL patch.

Results: The median Pearson correlation coefficients (CC) and root mean square error (RMSE) for each lead were calculated as follows (CC/RMSE): 0.986/74.3 μV (ST monitoring lead); 0.976/65.3 μV (spatially orthogonal lead).

Conclusion: We have developed coefficients that allow the derivation of a patch-based lead system from the 12-lead ECG using linear regression. Given the high correlation, it is possible to generate short spaced lead systems from existing diagnostic lead systems, however, amplitude errors are introduced in the process.