

Coefficients for the Derivation of Posterior and Right Sided Chest Leads from the 12-lead Electrocardiogram

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Background: The 12-lead ECG is spatially limited in diagnosing cardiac abnormalities. Expanded lead sets have been shown to increase the sensitivity of cardiac abnormality detection. Additional leads are inconvenient in a clinical setting, however, they can be derived. We aim to publish new coefficients capable of transforming the 12-lead ECG to include posterior leads (V7-V12) and right sided chest leads (V3R-V6R).

Method: Thoracic body surface potential maps (BSPM) were recorded from n=910 patients in two centres. Centre-one contained data (n=176) from 94 patients undergoing elective percutaneous coronary angioplasty (PTCA) in a clinical setting. Recordings were taken during both rest and peak balloon inflation inside three coronary arteries (LAD, LCX, RCA). Centre-two contained n=734 recordings in total from patients with myocardial infarction (n=271), left-ventricular hypertrophy (n=237) and healthy controls (n=226). All recordings were expanded to the 352-node Dalhousie torso using Laplacian interpolation. Data were split into training (75%) and test (25%) datasets. The eight independent channels of the 12-lead ECG were extracted for training (I, II, V1-V6). Coefficients were generated by linear regression of the 12-lead ECG to the posterior leads. Additional posterior lead coefficients from a related study were used for performance comparisons.

Results: The median correlation coefficients (CC) and root mean square error (RMSE) for each lead were as follows (CC/RMSE): 0.98/46 μV (V7); 0.96/52 μV (V8); 0.94/48 μV (V9); 0.91/39 μV (V10); 0.95/27 μV (V11); 0.97/24 μV (V12); 0.99/26 μV (V3R); 0.97/35 μV (V4R); 0.96/32 μV (V5R); 0.95/30 μV (V6R). The performance of posterior lead coefficients was compared to that previously published. Correlation of the new coefficients was significantly improved ($p < 0.05$) in leads V9, V11 and V12.

Conclusion: We have developed coefficients that allow the derivation of 10 additional leads from the 12-lead ECG. This has the potential to improve the diagnostic sensitivity of the 12-lead ECG.