Estimation Accuracy of a Reduced Lead System During Simulated Ischemia

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In this study we investigate the influence of ischemic events on the estimation accuracy of a reduced lead system that is based on leads I, II, V2 and V5. This assessment was carried out on a piecewise homogenous torso model. This model was used to simulate one normal (non-ischemic) and 25 ischemic Mason Likar (ML) 12-lead ECGs. The location and size of the 25 simulated ischemic events were chosen based on the coronary artery distribution. Precordial leads V1, V3, V4 and V6 were derived from leads I, II, V2 and V5 of the actual (simulated) ML 12–lead ECGs. Both patient specific and generalized transformation coefficients were tested. Differences between actual and derived leads were assessed by root mean square error (RMSE). RMSE values were calculated over the STT segment.

When ischemia was absent patient specific derivation yielded RMSE values of 4.7μV, 24.4μV, 4.4μV and 2.6μV for derived leads V1, V3, V4 and V6 respectively. It was found that RMSE values for patient specific derived leads increased when ischemia was simulated. Median RMSE values calculated for each lead and across all simulated ischemic events were found to be 40.0μV, 126.7μV, 38.2μV and 35.1μV for derived leads V1, V3, V4 and V6 respectively. These values are comparable to the median RMSE values obtained when generalized lead derivation was performed for all ischemic events (52.7μV, 141.7μV, 46.9μV and 20.3μV for respective leads). It was found that acute anterior myocardial infarction caused the largest differences between derived and actual precordial leads.

The findings presented in this study, raise questions about the superiority of the patient specific lead derivation approach for continuous monitoring. Further research on recorded 12-lead ECGs with ischemic episodes is required to confirm the simulation based.