Utilising a Genetic Algorithm to Minimise the Number of Leads in Body Surface Mapping for the Electrocardiographic Diagnosis of Myocardial Infarction

Peter Scott*, Cesar Navarro, Marisol Giardina, Omar Escalona, John Anderson and Jennifer Adgey

Cardiology, West Wing, Royal Victoria Belfast, Belfast, Antrim, United Kingdom

Introduction: The 80-lead Body Surface Map (BSM) is a diagnostic tool utilised by clinicians for the diagnosis of myocardial infarction (MI) at our centre. The optimum number and placement of leads on the BSM is uncertain. We used Genetic Algorithm analysis to determine a reduced lead system for the optimal diagnosis of MI. Method: 1106 cases presenting to our centre with ischaemic type chest pain (576 ST Segment Elevation MI, 244 Atypical ECG and 286 Non-MI) were recorded using the 80-lead BSM. All recordings were made within 12 hours of symptom onset. MI was confirmed by elevation of Troponin T $>$ 0.09 umol/l and BSM diagnosis and recording quality confirmed by retrospective analysis by two physicians. A Genetic Algorithm was developed to determine a subset of reduced number of leads, with their associated anatomical position within the 80-lead BSM system, while maintaining sensitivity and specificity for MI diagnosis. Additional weighting was included in the fitness function to encourage leadsets containing fewer electrodes as well as leadsets closer together on the torso (to aid lead placement). The Genetic Algorithm was run on two separate occasions (Run A and Run B) and the output compared with the 80-Lead BSM. Results: Run A produced a 24 lead system. The sensitivity and specificity for MI diagnosis was 86.40% and 97.55% respectively. Received Operator Characteristic (ROC) curve c-statistic was 0.805. Run B produced a 21 lead system with sensitivity and specificity of 84.84% and 98.25% respectively. ROC curve c-statistic was 0.811. This compares favourably with the 80 lead BSM (sensitivity 90%, specificity 92%, ROC c-statistic 0.850). Conclusion: We have developed a novel genetic algorithm based approach, in determining the optimal number ($<$25) and position of leads from the 80-lead BSM for the electrocardiographic diagnosis of MI.