

Alterations in 3D vectorcardiographic loop length in acute myocardial infarction patients: a quantitative study

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Cardiovascular diseases, especially acute myocardial infarction (AMI), are major global health concerns. The present study focuses on the QRS loop of the three-dimensional vectorcardiogram (VCG), a key indicator of ventricular electrical activities. By comparing healthy individuals and AMI patients, we found a notable decrease in QRS loop length among those with AMI measured using Euclidean point-to-point distances. This shortening suggests a clustering of vectors due to myocardial necrosis and disrupted electrical conduction. The findings emphasise the diagnostic value of QRS-based VCG analysis, offering insights into cardiac electrophysiology and highlighting its promise for early detection and predicting the prognosis of myocardial infarction.

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ventricles. However, the scalar representation of ECG limits the ability to fully capture the spatial dynamics of cardiac conduction². Therefore, a detailed analysis of the cardiac vectors propagating through the heart is essential.

The heart generates dynamic electrical dipoles or vectors that change over time and move throughout its chambers. Vectorcardiogram or VCG visually maps the path traced by the tips of cardiac vectors in three-dimensional (3D) space with respect to a fixed zero reference point³. VCG addresses the limitation of ECG by offering a 3D spatial representation of the heart's electrical vectors. VCG loops provide valuable insight into the direction, magnitude and polarity of instantaneous electrical activity in the heart⁴.

To study the activities of the cardiac ventricles, it is imperative to analyse the characteristics of the 3D-QRS loop, the portion of the spatial VCG that corresponds to ventricular depolarisation. The QRS loop is particularly significant as it reflects the primary vector changes during the most electrically active phase of the cardiac cycle.

In several earlier papers^{5,6}, there was qualitative