ORIGINAL ARTICLE

Value of pathologic Q wave in surface electrocardiography in the prediction of myocardial nonviability: A cardiac magnetic resonance imaging-based study

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ABSTRACT

In surface electrocardiography (ECG), Q wave is often considered as a sign of irreversibly scarred myocardium. Cardiac magnetic resonance (CMR) imaging is an accurate mean for the detection of myocardial viability. Herein, we study the predictive value of Q wave in nonviable (scarred) myocardium by CMR study. Retrospective analysis of the ECG and CMR data of 35 coronary artery disease patients was performed. The delayed enhancement CMR protocol was used for the detection of viability. The presence of a pathologic Q wave in surface ECG was negatively related to myocardial viability with a kappa measurement of agreement of −0.544 and $P < 0.0001$. Pathologic Q wave in surface ECG can be used as a simple tool for myocardial viability prediction.

Key words: Cardiac magnetic resonance, electrocardiography, myocardial, patients

INTRODUCTION

Chronic heart failure (CHF) is a major cause of morbidity and mortality, and its mortality rate is higher than many different cancers. Nowadays, coronary artery disease (CAD) is also a leading cause of heart failure.

Coronary revascularization in the setting of left ventricular (LV) dysfunction and evidence of myocardial viability results in improved clinical outcomes.

CHF patients with no evidence of viability may not gain the same extent of improved outcome as patients with a sufficiently viable myocardium.

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Although the routine evaluation of viability before revascularization is still controversial, many clinicians schedule CHF patients for such procedures if there is sizable amount of viable myocardial tissue.[1-4]

Many different methods are used for viability detection. Single photon emission computerized tomography (SPECT) methods are widely available and include thallium–201 SPECT and technetium–99 SPECT.[1]

18F-fluorodeoxyglucose (18F-FDG) positron emission tomography (PET) has also been used for this purpose.[1] Cardiac PET utilizing 18F-FDG is considered as the most sensitive modality for detecting viable myocardium and hence predicting LV functional recovery following coronary revascularization.[1]

Cardiac PET is not as widely available as SPECT imaging and interpretation experience may widely vary.[1]

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Other modalities commonly used for myocardial viability assessment include low-dose dobutamine stress echocardiography and cardiac magnetic resonance (CMR) imaging (MRI).

CMR is a rapidly growing field of cardiac imaging that has a promising potential for detecting myocardial viability. There are two common methods to assess viability with CMR: dobutamine stress CMR and delayed enhancement CMR (DE-CMR). The DE-CMR method takes advantage of kinetic properties of contrast agents to identify the regions of scarring.[1,5]

Among various methods of viability assessment, PET and CMR are generally considered as the preferred choices, due to their overall higher accuracy.[2]

In one study, the detection of myocardial infarction using 18F-FDG PET was closely related to contrast-enhanced CMR and use of PET as the gold standard; the sensitivity and specificity of CMR for the detection of myocardial viability were 96% and 84%, respectively.[6] In another study, a good correlation was established between CMR and PET.[7] CMR has a unique ability to assess small infarcts and to measure the transmural extent of myocardial infarction.[6]

In another study by Gerber *et al*. on patients with CAD and low ejection fraction, the prognostic value of myocardial viability was determined by CMR following revascularization.[8]

Q waves in surface electrocardiography (ECG) are often considered to be reflective of an irreversibly scared myocardium.[9-11] However, there are some indications, in which residual viable tissue may be present in the Q wave infarcted regions.[9]

There are studies that correlate Q wave in surface ECG and the presence of viability with dobutamine stress echocardiography,[9] SPECT,[10] and PET imaging.[12]

In one study, the presence of R wave on the surface ECG was used to predict myocardial viability in CMR.[11]

PET and CMR are relatively expensive, and their availability is also limited.

According to the above-mentioned data, we performed this study to determine if Q wave in surface ECG can predict myocardial scar (nonviability), based on the CMR examination.

METHODS

This was a retrospective study on 35 patients with a documented history of CAD who were referred to Shahid Rajaie Cardiovascular Medical and Research Center for assessment of myocardial viability.

Exclusion criteria were the presence of ST elevation or bundle branch block in baseline ECG. CMR was performed with Siemens Avanto, 1.5 T MRI scanner.

The assessment of viability was performed with DE-CMR images using 0.2 mmol/kg of Dotarem as contrast agent. We use 17-segment model and Delayed enhancement (DE) sequence for pathologic finding of ischemic scaring.

Viability was defined as <50% DE in more than three of the seven segments in the left anterior descending (LAD) territory and more than two of the five segments in the lateral and inferior LV regions.

ECG of the patients was analyzed by a single cardiologist who was blind to the DE-CER results. Pathologic Q wave was defined as any Q wave with more than 40 ms width or a depth more than one-third of the adjacent R wave.

Assessment of ECGs was performed based on the presence of pathologic Q wave in more than two adjacent anterior leads (V1-V5) for eft anterior descending artery; Inferior leads (II, III, aVF) for right coronary artery and lateral leads (I, aVL,V6) for left circumflex coronary artery.

We used SPSS version 13 (SPSS Inc., Chicago, IL, USA) for data analyses.

RESULTS

A total of 35 patients (15 males and 20 females) were studied; their mean age was 61 ± 9 years and the mean ejection fraction was 35.7 ± 16.1.

A total of 105 coronary domains in these 35 patients were analyzed. Altogether, 34 regions with ECG evidence of pathologic Q wave were detected in these 105 domains.

Pathologic Q wave in surface ECG has a measurement of agreement (κ) of −0.599 with myocardial viability of the related segment as $P < 0.0001$.

Q wave sensitivity for the detection of scaring (nonviability) was 81.25% whereas specificity and positive (PPV) and negative (NPV) predictive values were 93.15%, 83.87%, and 91.89%, respectively.

DISCUSSION

The aim of this retrospective study was to correlate the surface ECG changes to myocardial viability. A positive correlation between Q wave and myocardial nonviability (scar or necrosis) was determined in this study.

In the study by Al-Mohammad *et al*.,[12] Q wave was a specific (79%) but not sensitive (91%) indicator for nonviability with 77% PPV and 43% NPV. They used 18F-FDG for viability assessment.

In another study by Saber *et al*. using PET scan, chronic ST elevation after Q wave anterior myocardial infarction did not exclude viability.[13]

In the study of Schinkel *et al*. using dobutamine stress echocardiography, 58% of the regions related to chronic Q wave were viable. Hence, using their protocols, Q wave in surface ECG was not an accurate surrogate for the viability state of the myocardium.[9]

The study which is most compatible to ours is the one by Singh *et al*. They used DE-CMR for the detection of viability and compared the obtained data with the presence of R wave in surface ECG. They concluded that the presence of R wave is a highly sensitive and simple tool for predicting viability, with 96.5% sensitivity in the anterior lead and 99.3% in other leads.[11]

In our study, we used DE-CMR for the detection of viability which showed a meaningful correlation with PET imaging, as the gold standard for viability detection.

In contrast to Singh *et al*.'s study, we used Q wave as a marker of nonviability (or scar). Accordingly, a negative correlation was established between Q wave in surface ECG and viability ($\kappa = -0.544$) with favorable sensitivity and NPV.

This study had certain limitations. The first and most important was its small sample size. Q wave was used for prediction of scar whereas only one case of qR was found. Therefore, analysis of Q wave subgroups (qR or Qs) was not performed. It is possible that larger number of patients may change the sensitivity or specificity of Q wave in this respect. Of course, this was a retrospective study. Hence, prospective studies are highly recommended to further assess the value of surface ECG data in predicting the outcome, following revascularization or medical treatment.

CONCLUSION

Q wave in surface ECG is a simple tool with good accuracy for the detection of myocardial scaring in CAD patients.

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Conflicts of interest

There are no conflicts of interest.

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