Original Article

PATHOLOGIC Q-WAVE ON ECG AS A PREDICTOR OF NON-VIABLE MYOCARDIUM IN POST-MYOCARDIAL INFARCTION PATIENTS

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Author's Contribution

MSS:Conducted the study and wrote the article. MTM:Helped in review the article. NA:Re-arranged data and corrected article. FQ:Tables and figures. MAKS and ZRB made corrections and did the proof reading.

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ABSTRACT

OBJECTIVE: To determine the diagnostic accuracy of pathologic Q wave on ECG in predicting the presence of non-viable myocardium taking SPECT as gold standard.

MATERIALS AND METHODS: This validation study enrolled 150 patients of myocardial infarction referred to the Department of Nuclear Medicine for evaluation of myocardium viability with EF ≤50%, having age 30-70 years. The study duration was Oct-2019 to April-2020. 12 lead ECG was done to determine pathologic Q-waves on ECG. After ECG, all patients underwent SPECT scanning. SPECT was performed using Tc99 scanning protocol. Myocardium was considered non-viable if >10% of the LV myocardial tissue was found non-viable.

RESULTS: Mean age was 53.57±11.41 years. There were 124 (82.7%) male and 26 (17.3%) female patients. On ECG, pathologic Q-wave was present in 87 (58%) patients, while non-viable myocardium on SPECT was present in 110 (79.0%) patients. The sensitivity of Q-wave was 71.8%, specificity was 80.0%, PPV was 90.8% and NPV was 50.8%. Kappa statistics value was 0.43 which indicate moderate agreement.

CONCLUSION: Pathologic Q-wave on 12 lead ECG have average sensitivity and specificity for the diagnosis of non-viable myocardium. So in facilities where SPECT imaging is available, the consultant should rely on the SPECT findings instead of pathologic Q-waves for determination of irreversible myocardial scarring.

KEYWORDS: Pathologic Q-wave, Single photon emission computed tomography (SPECT), non-viable myocardium.

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INTRODUCTION:

Left ventricular (LV) impairment after myocardial infarction (MI) is the highly predictive factor of early mortality. Patients with severe dysfunction have very poor prognosis, if early revascularization is not established.[1,2] The scared myocardium do not get any benefit from early revascularization so determination of myocardial viability is very necessary in patients with LV dysfunction.[3,4]

Single photon emission computed tomography (SPECT) imaging is the gold standard for evaluation of myocardial viability and is highly sensitive for predicting myocardial recovery after MI. But the SPECT test is costly and available in well-equipped facilities.[5,6]

12-lead ECG is the primary test for determination of underlying cardiac pathology and to determine the presence and extent of MI. Some recent studies have reported that the presence of pathologic Q-wave scan accurately predict the presence of irreversible myocardial scarring.[7,8] The cardiologists are well aware that the ECG findings are not always reliable for accurate diagnosis. As the ECG findings are unpredictable in accompanying conditions such as bundle branch block (BBB), atrial fibrillation (AF), and non-STEMI. Moreover, there is paucity of literature including larger sample size in local as well as international literature concerning the accuracy of pathologic Q-wave on ECG for determination of irreversible myocardial scarring in MI patients.[9,10] So the present study is designed to determine the diagnostic accuracy of pathologic Q-wave on ECG to determine the irreversible myocardial scarring taking SPECT images as gold standard.

MATERIAL AND METHODS:

This validation study enrolled 150 patients of MI referred to the Department of Nuclear Medicine for evaluation of myocardium viability, EF ≤50%, having age 30-70 years. Patients with history of non-ST elevation myocardial infarction (NSTEMI), or bundle branch blocks were excluded. The study duration was Oct-2019 to April-2020. Approval from IRB of CPE institute of cardiology was taken.

Sample size was calculated by taking estimated frequency of non-viable myocardium in 32.38% patients of MI. Expected sensitivity of pathologic Q wave 81.25% and specificity 93.15% and desired precision level 12% for sensitivity and 5.0% for specificity.

Before performing SPECT imaging, 12 lead ECG was done to determine pathologic Q-waves on ECG. Determination of pathologic Q-wave was made according to the 3rd universal MI definition; (i) presence of Q-wave ≥0.02 seconds in lead V_2-V_3, or QS complex in lead V_2-V_3, (ii) Q-wave ≥0.03 seconds or ≥0.1 mVddeep or QSccomplex in leads I,III, aVL,aaVF, or V_4-V_6 in any22 leads of accontiguous lead grouping (I,aaVL; V_1-V_6; II,III,aVF).[11]

After ECG, all patients underwent SPECT scanning. SPECT was performed using Tc99 scanning protocol. Myocardium was considered non-viable if >10% of the LV myocardial tissue was found non-viable.

Data was analyzed using software SPSS version 25. Then 2×2 contingency table was made to calculate sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of pathologic Q-wave taking SPECT findings as gold standard. Kappa statistics values were also calculated.

RESULTS:

Mean age was 53.57±11.41 years. There were 124 (82.7%) male and 26 (17.3%) female patients who were referred for SPECT. Regarding risk morbidities, there were 73 (48.6%) diabetic, 78 (52.0%) hypertensive, 39 (26.0%) smokers, and 34 (22.6%) had dyslipidemia (Table 1).

On ECG, pathologic Q-wave was present in 87 (58%) patients, while non-viable myocardium on SPECT was present in 110 (79.0%) patients. The sensitivity of Q-wave was 71.8%, specificity was 80.0%, PPV was 90.8% and NPV was 50.8%. Kappa statistics are shown in (Table 2).

Table 1. Baseline Study Variables.

Age (Years)	53.57±11.41
Male/Female Gender	124 (82.7%)/26 (17.3%)
Diabetes (%)	73 (48.6%)
Smoking (%)	39 (26.0%)
Hypertension (%)	78 (52.0%)
Family History of CAD (%)	23 (15.3%)
Dyslipidemia (%)	34 (22.6%)

Table 2. Diagnostic Accuracy of Pathologic Q-Wave.

Q-Wave on ECG	**Non-viable Myocardium on SPECT**		***Total***
	Yes	**No**	
Yes	79	08	87
No	31	32	63
Total Number	110	40	150
Sensitivity	71.8%		
Specificity	80.0%		
PPV	90.8%		
NPV	50.8%		
Inter Rater Reliability Number of observed Agreement = 111 (74.0%) Number of agreed by chance = 80.6 (53.73%) Kappa value = 0.43 (95% CI = 0.299-0.58) Standard error of Kappa = 0.072			

DISCUSSION:

Determination of myocardial viability is one of the counter-stones to take management decisions in Post-MI patients, as it helps to decide either reperfusion will be of any benefit in patients with LV dysfunction.[12] Advancements in cardiac imaging modalities has made tremendous facilities for cardiologists and cardiac surgeons in this regard. SPECT is the gold standard test to determine irreversible scaring in suspected patients.[13]

However, in many centers SPECT facilities are not available and these cardiologists have to depend on ECG, exercise tolerance test (ETT), and ECHO findings for decision making in post-MI patients. These techniques can only provide limited information and sometimes the information provided is not accurate. Recently some studies have published that the pathologic Q-wave on ECG can predict myocardial scaring in post-MI patients.In acute ST-elevation MI patients, first there is ST segment elevation that resolves with time (from hours to days) to normal form and after that Q-wave with T-wave inversion comes on the ECG that persist for longer time period. Therefore, many of the post-MI patients present with Q-waves on ECG.[14]

In present study, we found that pathologic Q-wave on ECG is highly sensitive for diagnosis of myocardial scarring. We found that Q-wave is 71.8% sensitive, 80.0% specific, has PPV of 90.8% and NPV 50.8%.

A study by Arjmand et al. reported that pathologic Q wave on ECG is highly predictive of non-viable myocardium, they reported that pathologic Q wave is 81.25% sensitive and 93.15% specific for predicting non-viable myocardium taking PET images as gold standard. The authors found non-viable myocardium in 34/105 (32.38%) patients who were referred for SPECT.[15]

While a study by Raza et al. reported that pathologic Q wave on ECG is a very poor indicator of non-viability, they reported that pathologic Q wave is only 56.25% sensitive, and 36.58% specific for predicting non-viable myocardium.[16]

Another study by Nestaas et al. reported that Q-wave is 63.0% sensitive and 86% specific for diagnosis of myocardial scarring.[17]

The limitation of present study is that it is a single center study with limited sample size, so there is a need to conduct a large sample sized study involving multiple institutions to determine either ECG can determine non-viable myocardium or not.

CONCLUSION:

Pathologic Q-wave on 12 lead ECG have average sensitivity and specificity for the diagnosis of non-viable myocardium. So in facilities where SPECT imaging is available, the consultant should rely on the SPECT findings instead of pathologic Q-waves for determination of irreversible myocardial scarring.

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