Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v2023i1.558
*Biol. Clin. Sci. Res. J., Volume, **2023**: 558*
Original research article

ACCURACY OF PATHOLOGIC Q WAVE ON ELECTROCARDIOGRAPHY TO PREDICT NON-VIABLE MYOCARDIUM

HASHMI KA[1*], MAQBOOL S[2], KABEER HMA[3], AKHTAR A[3], KHATTAK S[1]

[1]*Department of Cardiology, Nishtar Medical University & Hospital Multan (NMU & H) Multan, Pakistan*
[2]*Department of Cardiology, Mukhtar A.Sheikh Hospital Multan, Pakistan*
[3]*Department of Cardiology, Ch. Pervaiz Elahi Institute of Cardiology (CPEIC) Multan, Pakistan*
**Correspondence author email address:* drkash226@gmail.com

(Received, 27th July 2023, Revised 20th October 2023, Published 30 November 2023)

Abstract: *A prospective study was conducted to determine the diagnostic accuracy of Q wave on ECG in predicting the non-viable myocardium in patients with myocardial infarction, considering SPECT as the gold standard in the Department of Nuclear Cardiology, Ch. Pervaiz Elahi Institute of Cardiology (CPEIC), Multan, from June 2022 to June 2023. A total of 414 patients with myocardial infarction were included in the study. Demographic and clinical data such as age, gender, smoking history, diabetes, and hypertension were collected. Before the SPECT scan, 12 lead ECG was done in all patients to determine the pathologic Q wave. Pathologic Q-wave on ECG was found in 252 (60.87%) and not in 162 (39.13%) patients. Non-viable myocardium on SPECT was found in 231 (55.80%) and not in 183 (44.20%) patients. Pathologic Q-wave was 68.80% sensitive and 49.20% specific, with 63.10% PPV and 55.60% NPV compared to SPECT. This difference was statistically significant (P<0.001). Development of pathologic Q wave on ECG was significantly associated with male gender (P =0.006), hypertension (P=0.008), and smoking (P=0.002). In conclusion, pathologic Q wave on ECG is a reliable tool for predicting non-viable myocardium in CAD patients.*

Keywords: Myocardial infarction, Electrocardiography, Coronary revascularization, SPECT

Introduction

Left ventricular impairment is the primary cause of mortality in patients with myocardial infarction (MI). Revascularization in these patients may improve prognosis (Chew et al., 2018; Melendo-Viu et al., 2020). Patients with viable myocardium have better outcomes and an increased chance of survival than those with non-viable myocardium (Erthal et al., 2019; Kandolin et al., 2019).

Single photon emission computed tomography (SPECT) is a highly effective tool for detecting myocardium viability and predicting coronary revascularization outcomes. However, it is costly, not readily available, and highly technique-sensitive (Malhotra et al., 2019; Solyman et al., 2018). 12 lead ECG is routinely used for diagnosing myocardial infarction. Pathologic Q wave on ECG predicts irreversibly scared myocardium (Abou et al., 2020; Dastidar et al., 2016).

Some recent studies have reported that the presence of Q waves on ECG in patients with LV dysfunction can predict the presence of non-viable myocardium. A study said that pathologic Q wave on ECG is highly predictive of non-viable myocardium. They reported that pathologic Q wave is 85.25% sensitive and 96.18% specific for predicting non-viable myocardium, taking PET images as a gold standard (Saleemia et al., 2020). A retrospective diagnostic accuracy study performed by Raza et al. on patients with a mean age of 58±10 years and male-to-female ratio of 6:1 reported that pathologic Q wave on ECG is not a good indicator of non-viability. They reported that the pathologic Q wave is only 56.25% sensitive and 36.58% specific for predicting non-viable myocardium (Raza et al., 2019).

The present study aims to determine the diagnostic accuracy of Q wave on ECG in predicting the non-viable myocardium in patients with myocardial infarction. SPECT test is a costly and time-consuming procedure available only in a few cardiology institutes in Pakistan. Thus, if pathologic Q wave on ECG is found to be accurate in predicting the presence of non-viable myocardium, the results of this study will offer a cheap and readily available tool for diagnosing non-viable myocardium in MI patients undergoing coronary revascularization.

Methodology

The prospective study was conducted in the Department of Nuclear Cardiology, CPE Institute of Cardiology, Multan, from June 2022 to June 2023. The study included patients aged from 30 to 70 years who had MI and were referred for assessment of myocardium viability. Patients with pacemakers, bundle branch blocks, or Wolff Parkinson White syndrome were excluded. Informed consent of the participants was taken. The ethical board of the hospital approved the study.

A total of 414 patients with myocardial infarction were included in the study. Demographic and clinical data such as age, gender, smoking history, diabetes, and hypertension were collected. Before the SPECT scan, 12 lead ECG was done in all patients to determine the pathologic Q wave. After that, SCPECT was done in all patients to assess the myocardial viability, and a nuclear medicine physician interpreted it for over three years. He was not aware of the study hypothesis and ECG findings. Diagnosis of non-viable myocardium was made as per operational definitions. All the relevant information for the study was noted on a pre-designed Performa.

[Citation: Hashmi, K.A., Maqbool, S., Kabeer, H.M.A., Akhtar, A., Khattak, S., (2023). Accuracy of pathologic Q wave on electrocardiography to predict non-viable myocardium. *Biol. Clin. Sci. Res. J.*, **2023***: 558*. doi: https://doi.org/10.54112/bcsrj.v2023i1.558]

Data analysis was performed by using SPSS v25. Mean and S.D. were calculated for quantitative data. Frequency and percentage will be calculated for qualitative variables such as gender, diabetes, hypertension, smoking, pathologic Q wave on ECG, and non-viable myocardium on SPECT. A 2×2 contingency table was used to calculate the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of pathologic Q-wave, taking SPECT findings as the gold standard. Effect modifiers, including gender, age, diabetes, hypertension, and smoking, were controlled through stratification. Post-stratification sensitivity, specificity, PPV, and NPV were calculated again. P- value < 0.05 was considered statistically significant.

Results

The Mean age of the participants was 48.17±9.68 years. There were 271 (65.46%) male and 143 (34.54%) female patients. There were 196 (47.34%) diabetic patients and 218 (52.66%) non-diabetic patients. Hypertension was found in 230 (55.56%) patients and not in 184 (44.44%). Out of 414, 148 (35.75%) patients were smokers.

Pathologic Q-wave on ECG was found in 252 (60.87%) and not in 162 (39.13%) patients. Non-viable myocardium on SPECT was found in 231 (55.80%), not 183 (44.20%) patients. Pathologic Q-wave was 68.80% sensitive compared to SPECT, 49.20% specific, 63.10% PPV, and 55.60% NPV. This difference was statistically significant (P<0.001) (Table I).

There was no association between age and pathologic Q-wave on ECG. In patients aged 30-45, pathologic Q-wave on ECG was 71.70% sensitive, 68.10% specific, having 55.80% PPV and 60.00% NPV (P<0.001). In patients aged 46-70, pathologic Q-wave on ECG was 66.10% sensitive, 58.60% specific, having 43.30% PPV and 51.20% NPV (P=0.158). Results of stratification based on gender, diabetes, hypertension, and smoking are shown in Table II. Development of pathologic Q wave on ECG was significantly associated with male gender (P =.006), hypertension (P=.008), and smoking (P=.002).

Table I Comparison of pathologic Q-wave on ECG with non-viable myocardium on SPECT

Pathologic Q-wave on ECG	Non-viable Myocardium on SPECT		P-value
	Yes	No	
Yes	159	93	
No	72	90	<0.001

Table II Association of Pathologic Q-wave on ECG and Non-viable Myocardium on SPECT with study variables

Variable	Pathologic Q-wave on ECG	Non-viable Myocardium on SPECT		P value
		Yes	No	
Age				
30-45	Yes	81	38	<0.001
	No	32	48	
46-70	Yes	78	55	0.158
	No	40	42	
Gender				
Male	Yes	103	62	0.006
	No	48	58	
Female	Yes	56	31	0.011
	No	24	32	
Diabetes	Yes	82	46	0.057
	No	34	34	
Hyper tension	Yes	92	55	0.008
	No	37	46	
Smoking	Yes	58	28	0.002
	No	26	36	

Discussion

In patients with MI, assessing viable/non-viable myocardium is essential to make accurate management decisions. With the advancement of technology, SPECT and MPI have been used to determine myocardium. However, many physicians still prefer conventional 12-lead ECG, stress ECG/ETT, and 2-D echo for evaluation and subsequent treatment planning (Shao et al., 2017; Yao et al., 2021). Studies have indicated that the approach alone may be inadequate and that MPI should be used for cardiac evaluation and treatment planning (Trägårdh et al., 2017). Molecular and functional imaging modalities such as MPI, perfusion gold standard, and cardiac magnetic resonance are used to assess non-viable myocardium; however, these are costly and not readily available. In this study, we determined the diagnostic accuracy of Q waves on ECG in detecting non-viable myocardium. It is challenging to compare the study results with previous literature due to the scarcity of data on the accuracy, sensitivity, and specificity of 12 lead ECG for detecting non-viable myocardium. However, many studies have been conducted on the utility of 12 lead ECG for assessing MI. In most studies, the accuracy of 12 lead ECG has been tested and compared with coronary angiography as a reference standard. Few studies have used MPI, PET, stress echo, cardiac magnetic resonance, or functional MRI as the gold standard for assessing the validity of 12 lead ECG for assessing MI or myocardial viability (Dyna et al., 2019; Mirbolouk et al., 2020; Rehman et al., 2019).

[Citation: Hashmi, K.A., Maqbool, S., Kabeer, H.M.A., Akhtar, A., Khattak, S., (2023). Accuracy of pathologic Q wave on electrocardiography to predict non-viable myocardium. *Biol. Clin. Sci. Res. J.*, **2023***: 558*. doi: https://doi.org/10.54112/bcsrj.v2023i1.558]

In the current study, compared to SPECT, the sensitivity of Q waves on 12 lead ECG was 68.08%, specificity was 49.20%, PPV was 63.10%, and NPV was 55.60%. A study by Arjmand et al. reported that pathologic Q wave on ECG is highly predictive of non-viable myocardium. They found that pathologic Q wave is 81.25% sensitive and 93.15% specific for predicting non-viable myocardium, taking PET images as the gold standard. The authors found non-viable myocardium in 34/105 (32.38%) patients referred for SPECT(Arjmand et al., 2018). On the other hand, a study by Raza et al. reported that pathologic Q wave on ECG is not a good indicator of non-viability. They wrote that pathologic Q wave is only 56.25% sensitive and 36.58% specific for predicting non-viable myocardium(Raza et al., 2019).
The limitation of our study is the small sample size. A more extensive study is recommended for additional evaluation. Moreover, a single observer interpreted MPI and ECG results, which may be subjected to error. MPI SPECT with Tc-99m MIBI was used as a gold standard, which may result in overestimation of non-viable myocardium.

Conclusion

Pathologic Q wave on ECG is a reliable tool for predicting non-viable myocardium in CAD patients.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate.
Approved by the department Concerned.
Consent for publication
Approved
Funding
Not applicable

Conflict of interest

The authors declared an absence of conflict of interest.

References

Abou, R., Prihadi, E. A., Goedemans, L., van der Geest, R., El Mahdiui, M., Schalij, M. J., Ajmone Marsan, N., Bax, J. J., and Delgado, V. (2020). Left ventricular mechanical dispersion in ischaemic cardiomyopathy: association with myocardial scar burden and prognostic implications. *European Heart Journal-Cardiovascular Imaging* **21**, 1227-1234.

Arjmand, A., Eshraghi, A., Sani, Z. A., Firouzi, A., Sanati, H. R., Nezami, H., Jalalyazdi, M., and Ghiasi, S. S. (2018). Value of pathologic Q wave in surface electrocardiography in the prediction of myocardial non-viability: A cardiac magnetic resonance imaging-based study. *Journal of Advanced Pharmaceutical Technology & Research* **9**, 162.

Chew, D. S., Wilton, S. B., Kavanagh, K., Southern, D. A., Tan-Mesiatowsky, L. E., Exner, D. V., and Investigators, A. (2018). Left ventricular ejection fraction reassessment post–myocardial infarction: Current clinical practice and determinants of adverse remodeling. *American heart journal* **198**, 91-96.

Dastidar, A. G., Carpenter, A., Rodrigues, J. C., Wilson, C. R., Kestenbaum, S. R., Baritussio, A., Palazzuoli, A., Nightingale, A. K., Baumbach, A., and Bucciarelli-Ducci, C. (2016). Role of 12 lead ECG Q-waves as a marker of myocardial infarction in the era of cardiac magnetic resonance. *Journal of Cardiovascular Magnetic Resonance* **18**, 1-2.

Dyna, D. T., Benjamin, B., and Francy, L. (2019). Correlation between the diagnostic accuracy of the electrocardiogram and coronary angiography in localization of occluded artery in acute ST-elevation myocardial infarction: A single-center experience. *Heart India* **7**, 105-109.

Erthal, F., Wiefels, C., Promislow, S., Kandolin, R., Stadnick, E., Mielniczuk, L., Ruddy, T., Small, G., and Beanlands, R. (2019). Myocardial viability: From PARR-2 to IMAGE HF-current evidence and future directions. *International Journal of Cardiovascular Sciences* **32**, 70-83.

Kandolin, R. M., Wiefels, C. C., Mesquita, C. T., Chong, A.-Y., Boland, P., Glineur, D., Sun, L., Beanlands, R. S., and Mielniczuk, L. M. (2019). The current role of viability imaging to guide revascularization and therapy decisions in patients with heart failure and reduced left ventricular function. *Canadian Journal of Cardiology* **35**, 1015-1029.

Malhotra, S., Gomez, J., and Doukky, R. (2019). Assessment of myocardial viability using single-photon emission computed tomography myocardial perfusion imaging. *Current Opinion in Cardiology* **34**, 473-483.

Melendo-Viu, M., Abu-Assi, E., Manzano-Fernández, S., Flores-Blanco, P. J., Cambronero-Sánchez, F., Pérez, D. D., Fernández, M. C., Galian, M. J. S., Molina, M. G., and Caneiro-Queija, B. (2020). Incidence, prognosis and predictors of heart failure after acute myocardial infarction. *REC: CardioClinics* **55**, 8-14.

Mirbolouk, F., Salari, A., Riahini, F., Moayerifar, M., Norouzi, S., and Gholipour, M. (2020). Electrocardiographic Changes and Coronary Findings in Patients with Acute non-ST-Elevation Myocardial Infarction: A Cross-Sectional Study. *Jundishapur Journal of Chronic Disease Care* **9**.

Raza, M., Naz, Z., and Dar, Z. S. (2019). Validation of ECG-based, post-myocardial infarction (post-mi) estimation of non-viable myocardium through technetium-99m methoxyisobutylisonitrile singe photon emission computed tomography (TC-99M MIBI SPECT). *Pakistan Armed Forces Medical Journal* **69**, S464-69.

Rehman, S., Li, X., Wang, C., Ikram, M., Rehman, E., and Liu, M. (2019). Quality of care for patients with acute myocardial infarction (AMI) in Pakistan: a retrospective study. *International journal of environmental research and public health* **16**, 3890.

Saleemia, M. S., Mohyuddina, M. T., Ahmada, N., Qadira, F., Sherwania, M. A. K., and Butta, Z. R. (2020). PATholoGIC Q-WAVE on ECG AS A PrEDICTor of non-VIAblE MyoCArDIuM In PoST-MyoCArDIAl InfArCTIon PATIEnTS. *MEMBErs intErnAtionAL* **16**, 157.

Shao, X., Yang, Y., Wang, Y., Qian, Y., and Wang, J. (2017). The amount of viable myocardium predicts left ventricular functional improvement and volume reduction in patients with coronary artery disease after coronary artery bypass grafting. *Int J Clin Exp Med* **10**, 13491-9.

Solyman, M., Arafa, O. A., Alam Eldeen, M. H., and Ali, S. (2018). MRI assessment of left ventricle myocardial viability in patients with chronic coronary artery disease in comparison with single photon emission computed tomography. *Sohag Medical Journal* **22**, 274-283.

Trägårdh, E., Tan, S. S., Bucerius, J., Gimelli, A., Gaemperli, O., Lindner, O., Agostini, D., Übleis, C., Sciagra, R., and Slart, R. H. (2017). Systematic review of cost-effectiveness of myocardial perfusion scintigraphy in patients with ischaemic heart disease: a report from the cardiovascular committee of the European Association of Nuclear Medicine. Endorsed by the European

Association of Cardiovascular Imaging. *European Heart Journal-Cardiovascular Imaging* **18**, 825-832.

Yao, Y., Wang, D.-W., Fang, W., Tian, Y.-Q., Shen, R., Sun, X.-X., Guo, F., Chu, K.-W., Cui, C., and Zhao, S.-H. (2021). Evaluation of left ventricular volumes and ejection fraction by 99m Tc-MIBI gated SPECT and 18 F-FDG gated PET in patients with prior myocardial infarction. *Journal of Nuclear Cardiology* **28**, 560-574.

[Citation: Hashmi, K.A., Maqbool, S., Kabeer, H.M.A., Akhtar, A., Khattak, S., (2023). Accuracy of pathologic Q wave on electrocardiography to predict non-viable myocardium. *Biol. Clin. Sci. Res. J.*, **2023***: 558*. doi: https://doi.org/10.54112/bcsrj.v2023i1.558]