

Using risk factors to help in the diagnosis of acute myocardial infarction in patients with non-diagnostic electrocardiogram changes in emergency department

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Received: 21 April 2014

Accepted: 14 July 2014

Published online: 23 August 2014

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Competing interests: The authors declare
that no competing interests exist.

Funding information: There is none to be
declared.

Citation: Dolatabadi AA, Kashani P,
Hatamabadi H, Kariman H, Baratloo A.
Using risk factors to help in the diagnosis
of acute myocardial infarction in patients
with non-diagnostic electrocardiogram
changes in emergency department. *Journal
of Emergency Practice and Trauma* 2015; 1
(1): 3-6.

Abstract

Objective: This study aimed to determine the association of cardiac risk factors and the risk of Acute Myocardial Infarction (AMI) in Emergency Department (ED) patients with non-diagnostic ECG changes.

Methods: This cross-sectional study was conducted in the ED of Imam Hossein Hospital during a period of one year. In this study, patients with symptoms suggestive of AMI including chest pain, dyspnea, palpitation, syncope, cerebrovascular incidents, nausea, vomiting, dizziness and loss of consciousness were included. The demographic data and risk factors, such as age, gender, history of diabetes, Hypertension (HTN), Hyperlipidemia (HLP), renal failure, positive family history of Coronary Artery Disease (CAD), smoking, substance abuse, alcohol consumption within the past 24 hours and cocaine use within the past 48 hours were recorded. Non-diagnostic ECG included: normal, non-specific, abnormal without ischemic symptoms such as old bundle branch block, Left Ventricular Hypertrophy (LVH), etc. The final diagnosis of AMI was determined by Creatine Phosphokinase-MB (CPK-MB) serum markers and Troponin I. The data were analyzed by using SPSS V. 20 and the level of statistical significance was considered to be $P < 0.05$.

Results: HTN, HLP, family history of heart disease were significantly higher in those who had non-diagnostic ECG ($P < 0.05$). However, the ischemic heart diseases were significantly lower in those with non-diagnostic ECG. History of diabetes, stroke, renal failure, alcohol or opium and menopause showed no significant association with non-diagnostic or diagnostic ECG.

Conclusion: Overall, the risk factors are limitedly associated with the occurrence of Myocardial Infarction (MI) in cases where ECG is not diagnostic and it is better to use other criteria to diagnose AMI.

Keywords: Risk factor, Acute myocardial infarction, Emergency department, Electrocardiogram

Introduction

Each year more than 5 million patients are admitted to the Emergency Departments (EDs) with chest pain, which constitutes about 5% of all patients admitted to the EDs. Chest pain is a symptom that can be caused due to many life-threatening diseases, and encompasses broad differential diagnoses. Accurate diagnosis of the patients with chest pain admitted to the ED is one of the most difficult tasks to be done by physicians of EDs.

Physician cannot diagnose approximately 3-5% of the cases of Myocardial Infarction (MI). Accurate and timely diagnosis of heart diseases is extremely important because these are among the reasons for most common ED admissions, where more than half of ED visits are due to heart

diseases. Patients with acute chest pain and non-diagnostic ECG changes constitute a problematic diagnostic group in terms of heart diseases and the cardiac origin of their diseases are determined only in 10-15% of cases, and 15% of them develop MI. About 5-10% of patients are misdiagnosed and develop MI within the next 48 hours. As epidemiologic markers, risk factors play a role in the diagnosis of heart diseases, and in patients whose diagnoses have been proven, they assist the increasing or decreasing of the likelihood of the diseases. An appropriate clinical assessment and detailed history, assessment of risk factors and physical examination play a key role in the differential diagnosis of the pains around the heart.

Chest pain accompanied with normal ECG or ECG with



little changes cannot rule out the probability of coronary occlusion. This does not mean that pain is of no cardiac origin. It has been shown in a study that about 15-25% of patients with chest pain admitted to the ED will be affected by acute coronary syndrome within the next 30 days. It has also been observed that 2.1% and 2.3% of the patients who have had MI and unstable angina respectively, had been initially diagnosed incorrectly. A previous study showed that from 241 patients, 11 patients (4.6%) were incorrectly diagnosed in terms of MI and among 157 patients 4/6% (n= 10) were incorrectly diagnosed regarding unstable angina. A research has shown that only in less than 7% of patients, ECG cannot show the MI risk.

In another study, it has been shown that in patients who have non-diagnostic ECG, risk factors are not significantly associated with MI risk and only Hypertension (HTN) is the most common risk factor effective in the detection of AMI. A study in an ED has shown that the use of cardiovascular risk factors in the diagnosis of Acute Coronary Syndrome (ACS) is not useful, and plays no role in the final assessment and treatment decisions for patients. Given the scarcity of studies on risk factors associated with Acute Myocardial Infarction (AMI), this study aimed to identify the risk factors to help the diagnosis of AMI in EDs in cases where ECG changes are not diagnostic.

Methods

This cross-sectional study was conducted over a period of two years from December 2006 until December 2008 at Imam Hossein Hospital. Patients with symptoms suggestive of heart diseases including chest pain, palpitations, dizziness, weakness and lethargy, shortness of breath, cold sweat, syncope, loss of consciousness, Cerebrovascular Accident (CVA), nausea and vomiting admitted to the ED, and who had non-diagnostic ECG changes were included. Patients were checked in terms of CK-MB and Troponin I. Primary ECG changes were approved by the hospital's cardiologist.

Non-diagnostic ECG included:

- Normal
- Early repolarization
- Abnormal ECG without ischemic symptoms [old Left Bundle Branch Block (LBBB), Left Ventricular Hypertrophy (LVH), etc]
- Previous abnormal ECG without new ischemic symptoms

Then the history of the specified risk factors in the patients was determined. The risk factors included diabetes, HTN, Hyperlipidemia (HLP), and positive family history in the first-degree relatives, renal failure, and history of CVA, smoking, alcohol consumption within the past 24 hours before admission, history of hospitalization in CCU and previous history of coronary disease, menopause and substance abuse. The data of the patients was recorded in the checklist. Final diagnosis of AMI was conducted based on CK-MB or Troponin I values. The data were analyzed

by using SPSS version 20 and the level of statistical significance was considered to be $P < 0.05$.

Results

Totally 474 patients were included in this study, of whom 324 patients had diagnostic ECG changes, while 150 subjects had non-diagnostic ECG changes. The mean age of participants was 68 years, who were in the age range of 32-90 years old; 240 patients were male and 234 were female. Chief complaint of the patients showed that the most common symptom was chest pain during admission as it was diagnosed in 25% of the people. Among them, 75% had retrosternal pain while 25% suffered from precordial pain. Totally, 44% of the patients with chest pain had a positive response to sublingual TNG; 64% suffered from chest pain at rest and 45% complained of shortness of breath.

Palpitation was observed in 3% of the patients, syncope in 8%, and weakness in 16%, changes in the level of consciousness in 8%, and dizziness in 9% of patients. In addition, 25% of patients suffered from nausea and vomiting, and 40% from cold sweat.

The onset of the symptoms of the patients was evaluated and in 291 patients, the symptoms started in the morning of the admission date, in 141 patients in the evening and in 42 patients at night. Among the examined patients, the heart sound was normal in 370 patients, it was soufflé in 40 cases, and in 64 cases of S3 or S4 was heard; 382 persons showed normal lung sound, and 80 patients had rales at the pulmonary base.

Totally, 352 people had positive CK-MB and 304 had positive Troponin I test, and in 340 patients CK-MB and Troponin I were positive.

Table 1 shows the evaluation of risk factors in patients with diagnostic and non-diagnostic ECG. HTN, HLP, family history of heart disease were significantly higher in those who had non-diagnostic ECG ($P < 0.05$). However, the ischemic heart diseases were significantly lower in those with non-diagnostic ECG. History of diabetes, stroke, renal failure, alcohol or opium and menopause showed no significant association with non-diagnostic or diagnostic ECG.

Discussion

The findings of this study indicate that the possibility of facing with normal or non-diagnostic ECG in patients who suffered from MI and had a history of HTN, HLP, and family history of heart diseases is higher than others. However, the previous history of MI reduces the chance of non-diagnostic ECG. HTN, increased blood lipid levels and positive family history have been known to increase the chances of MI for a long time now (1,2). These factors are the most important factors that, if not controlled, will cause MI in different age groups. However, the present study showed that these factors not only increase the risk of MI but also will make the diagnosis of this disease, and possibly other coronary artery problems, more chal-

Table 1. Evaluation of risk factors in patients with diagnostic and non-diagnostic ECG

Risk Factors	D-ECG N (%)	ND-ECG N (%)	P-value
DM	112 (34)	45 (30)	
HTN	135 (42)	83 (55)	*
HLP	40 (12)	49 (48)	*
IHD	152 (47)	54 (36)	*
CVA	15 (10)	5 (1.5)	
RF	15 (10)	5 (1.5)	
Smoking	96 (21)	45 (30)	
Alcohol	48 (32)	22 (7)	
Opium	24 (16)	64 (20)	
Family History	24 (7)	64 (42)	*
Menopause	92 (61)	40 (12)	

D-ECG, Diagnostic ECG; ND-ECG Non-Diagnostic ECG; DM, Diabetes Mellitus; HTN, Hypertension; HLP, Hyperlipidemia; IHD, Ischaemic Heart Disease; CVA, Cerebrovascular Accident; RF, Rheumatic Fever.

*indicated the $P < 0.05$

lenging.

Available studies acknowledge that supplemental tests such as CK-MB and Troponin I in the case of normal ECG can be used for the diagnosis of MI. In one of these studies, Gibler *et al* showed that serial assessment of CK-MB within the first 3 hours had the diagnostic sensitivity and specificity of 96% (3). Other people believed that Troponin I was even more sensitive in the identification of MI (4).

Compared to other researches, a study by Kashani suggested that HTN, HLP and family history of MI factors were three common factors seen in patients with MI who had normal ECG (5). Conti *et al* showed in a study that in patients with chest pain and non-diagnostic ECG, HTN was a significant risk factor associated with increased risk for Coronary Artery Disease (CAD) (6). However, a study by Sanchis *et al* demonstrated that increased blood pressure and serum cholesterol level could predict the outcome of chest pain accompanied with normal ECG and Troponin I (incidence of MI or death) (7). Similar studies have also reported similar findings (8). One reason for the differences in such findings is the difference between the studied populations. For example, in the study by Sanchis *et al* (7) abnormal Troponin I was considered as one of the exclusion criteria, while this was not the case for the present study. Second, the difference in endpoint is an important confounding factor in the interpretation of the results.

Despite impressive advances in patient management strategies, including diagnostic algorithms, detailed clinical evaluations and advanced diagnostic tools, diagnosis of ischemia and MI in patients with chest pain and normal or non-diagnostic ECG (low-risk group for heart accidents), has been a serious challenge for clinicians in recent decades (9-11). However, the low level of incidence

of complications such as death or MI has been reported in these patients (7), but since these complications are dangerous, it is not reasonable to ignore them. In recent years great efforts have been undertaken to develop instructions for more accurate monitoring of low-risk patients, so that complications and adverse outcomes in these patients can be reduced further. This research attempted to identify the baseline and the demographic criteria that may be helpful in the diagnosis of MI in low-risk patients. Based on the findings, HTN, HLP and family history are three major factors that increase the risk of MI. Thus, it is suggested that in future studies, a scoring system based on demographic and baseline factors, medical history, clinical evaluation and diagnostic tests be developed, so that emergency physicians be able to decide about the management of the patients with chest pain who have normal or non-diagnostic ECG with confidence. Although there are several scoring systems currently available, such models have low sensitivity and specificity (7,12-14). Moreover, all factors relevant to cardiac diseases have not been included in them. This has reduced the accuracy of these systems.

Conclusion

The findings of this study showed that HTN, HLP, and family history of MI in people with non-diagnostics ECG are associated with increased risk of MI. However, other variables were not significantly associated with the disease. Accordingly, it is proposed that in the development of a scoring system and determining the risk of heart diseases in patients with chest pain, particular attention should be paid to HTN, HLP, and family history of MI.

Ethical issues

This study is compatible with Helsinki Rules for ethics in research studies and the study protocol was approved by ethical committee of Shahid Beheshti University of Medical Sciences.

Authors' contributions

All authors contribute in drafting/revise the manuscript, study concept or design, analysis or interpretation of data.

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