Original Article

POSITIVE PREDICTIVE VALUE OF HYPERACUTE T-WAVES IN ECG FOR THE DIAGNOSIS OF SIGNIFICANT DISEASE IN PROXIMAL LEFT ANTERIOR DESCENDING ARTERY

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Author's Contribution

RY:Conducted the study and wrote the article. AM:Helped in review the article. KEA:Re-arranged data and corrected article.AN:Tables and figures. MAI and AN were corrections and did the proof reading.

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ABSTRACT:
INTRODUCTION: Coronary artery disease (CAD) is the major cause of cardiovascular mortality throughout the world. Patients of CAD having distinct ECG pattern of hyperacute T-waves in the absence of ST-segment elevation has high positive predictive value (PPV) for the diagnosis of significant disease in left anterior descending artery (LAD). This study was conducted to calculate the positive predictive value of hyperacute T-waves in ECG of patients with CAD for the diagnosis of significant disease in proximal LAD artery.
MATERIALS AND METHODS:This cross sectional observational study was conducted in emergency department of Punjab Institute of Cardiology, Lahore over a period of six months. Patients fulfilling inclusion criteria underwent 12 lead ECG. Cardiac enzymes were taken to diagnose acute coronary syndrome. Management of ACS was done in standard way and patients were shifted to angiography Lab to see lesions of coronary arteries.
RESULTS:Two hundred patients were included in the study who presented with ACS. The patients ranged from 27 to 70 years with the mean age of 52.90±10.34 years. Out of 200 patients 152(76%) were male and 48(24%) were females. Positive predictive value of hyperacute T-waves was 89% for the diagnosis of significant lesion in left anterior descending artery(LAD).
Conclusion:
Hyperacute T-waves in the absence of ST-segment elevation has high positive predictive value on ECG and may be indicative of significant disease in LAD. The presence of hyperacute T-waves on ECG may be helpful to make decision about reperfusion therapy.
Key Words: Acute coronary syndrome , coronary artery disease(CAD), Left anterior descending artery(LAD), Hyperacute T-waves.

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INTRODUCTION

Coronary artery disease (CAD) is the major basis of cardiovascular mortality throughout the world. More than 2200 American die of CAD each day at an average of 1 death every 39 seconds.[1] It has been projected that by 2020 cardiovascular diseases will be the most important cause of death worldwide.[2]

The ECG (Electrocardiography) is a non-invasive and valuable tool applied to determine the infarct related artery in CAD and is diagnostic in 50-85% of symptomatic cases. About 1- 21% CAD patients with significant disease in proximal part of LAD had hyperacute T-waves on ECG in precordial leads i.e. lead V1 to V6, which do not evolve into ST-Segment elevated myocardial infarction[3]. This phenomena of hyperacute T-waves with well protected myocardium is due to collateral coronary circulation[4]. A study published in New England Journal of Medicine showed that this particular ECG pattern was percent in 30 out of 1532 patients (2.0%) of anterior myocardial infarction[5,6]. Another study published in Heart Journal concluded that out of 1890 patients of anterior myocardial infarction , 35(2%) were having such distinct ECG pattern with 100% positive predictive value with margins of false positive result. Since assumed to be 85%, because benign early repolarization of T-waves & left ventricular hypertrophy can effect the results[4].

Hyperkalemia, significant stenosis in proximal LAD artery and pericarditis remains the three major causes of hyperacute precordial T-waves. In hyperkalemia and pericarditis, the T-waves are tall, symmetrical, pointed, and tented as if pinched from above in all 12 leads of ECG, but in patients with significant disease in proximal LAD artery, the T-waves are tall, narrow with upward sloping and ST segment depression at J point in chest leads only[5].

Patients with significant stenosis in LAD artery present with typical cardiac chest compression and associated symptoms of anterior myocardial infarction and ECG shows 1-3mm hyperacute T-waves in chest leads.[6] This sort of T-wave behavior makes it difficult to diagnose acute STEMI and thrombolytic guidelines demand us to wait till ST segment elevation to occur. The other simple solution is to shift the patient to cardiac catheterization laboratory and to find out what exactly is happening in LAD artery[6]. Purpose of the study is to recognize the characteristic changes in ECG and correlate it with coronary angiography and help to make out further decisions regarding immediate reperfusion therapy to save the myocardium. In Pakistan previous studies have been done on coronary artery diseases but yet no study has examined the relationship of hyperacute T-waves with significant stenosis in proximal LAD artery[7]. This study will set a baseline data regarding cardiac patient management and will determine the positive predictive value of hyperacute T-waves in ECG of patients with CAD for the diagnosis of significant disease in proximal LAD artery.

MATERIALS AND METHODS:

This cross sectional study was conducted at emergency department and department of Interventional Cardiology, Punjab Institute of Cardiology Lahore over a period of six months from 7th Jan, 2013 to 6th July, 2013. 200 cases were calculated with confidence interval of 95% with margin of error 5% and taking assumed percentage of positive predictive value of hyperacute T-waves in ECG, i.e. 85% for the diagnosis of significant disease in proximal LAD artery. Consecutive non probability sampling was done. The patients with age more than 25 years presenting for the first time, both genders, chest pain indicative of myocardial ischemia lasting more than 30 minutes, ECG showing symmetrical hyperacute T-waves in precordial leads (Tall, upward slopping symmetrical T-waves of 1-3 mm amplitude in leads V1-V6 recorded on standard 12 lead ECG) were included. The patients with prior MI or revascularization, suffering from acute ST segment elevated myocardial infarction, hyperkalemia having serum potassium level more than 6mEq/L, anemia having hemoglobin less than 10g/dL, Renal failure patients having serum creatinine level more than 2mg/dl, documented pericarditis clinically or on echocardiography, patients not willing for coronary angiography were excluded.

All the patients meeting the inclusion criteria were then subjected to coronary angiogram and severity of disease in proximal LAD (More than 50% stenosis in proximal part of left anterior descending artery on coronary angiography) was assessed.

RESULTS:

200 patients with ACS were included in the study which ranged from 27 to 70 years age and the mean of age was 52.90±10.34 years. Out of 200 patients 152(76%) were males and 48(24%) were females. ECG of these 200 patients included in study showed ST-segment changes from V1-V6 leads. It was noticed that there was ST-segment depression at J-point(>1mm) with upward sloping of ST-segments which continued into tall, symmetrical

Table-Positive Predictive Value of Hyperacute T-waves in significant Proximal LAD stenosis:

	Stenosis in proximal LAD artery		Total
	Significant	Non-significant	
Hyperacute T-waves	178 (89%)	22 (11%)	200

True Positive: patients having hyperacute T-waves on ECG & significant disease in proximal LAD artery = 178
False Positive: Patients having hyperacute T-waves on ECG but not having significant disease in proximal LAD artery = 22
PPV: Patients having hyperacute T-waves on ECG & significant lesion in proximal LAD artery/ Patients having hyperacute T-waves on ECG with and without significant lesion in proximal LAD artery.
PPV: = TP / (TP + FP)
PPV: = 178 / (178 + 22) =89%

T-waves in anterior chest leads. Most of the ECG's showed narrow QRS complexes and some patients showed poor R wave progression from V1-V6. If there was poor R-wave progression, it was noticed that reciprocal ST-segment depression was present in inferior leads. To further analyze the absence of ST-segment elevation, we evaluated the ECG & angiography findings. On coronary angiography the disease in proximal LAD, if present was considered to be significant. 10% of patients showed large wraparound LAD and collateral filling of left anterior descending artery. 89% patients were having significant LAD stenosis in proximal part. Despite reperfusion in all cases, there was substantial loss of myocardium with elevated cardiac markers. The positive predict value of hyper acute T waves was calculated and it was found to be 89% which is quite significant.

DISCUSSION:

The major etiology of death in the United States and other Western countries is development of atherosclerotic process of coronary arteries. These developed countries have started the public awareness programs for the prevention of ischemic heart disease but despite these efforts they are unable to control the common and important risk factors for ischemic heart disease which includes diabetes mellitus, hypertension, smoking, obesity and hyperlipidemia. These modifiable risk factors if controlled can help to decrease the prevalence of cardiovascular morbidity and mortality[9].

The Framingham study data showed that approximately 35% of cases with coronary artery disease showed normal levels of total cholesterol (ie, < 200 mg/dL). These findings indicate the necessity for markers that can better forecast cardiovascular risk in the population. A report published in 2003 by the American Heart Association showed that serum C-reative protein may be used as a simple tool for the prevention and development of future CAD[10].

An important and cost effective investigation that is readily available in almost every hospital is ECG. It can be used to analyze the severity of ischemia in patients presenting with chest pain and within few minutes risk stratification can be done. One important finding is presence of hyper acute T waves in precordial leads which should be given importance and invasive workup may be considered.

In our study a unique ECG pattern was noticed in subjects with acute ischemic chest pain that predicted significant disease in proximal left anterior descending artery in the absence of ST-segment elevation on ECG. The PPV of this unique ECG pattern in correlation to significant LAD stenosis in proximal part was 100% in international studies, not ruling out false positive cases. And angiographic findings showed significant disease or occlusion of proximal part of LAD artery which warranted urgent reperfusion therapy preferably with primary angioplasty. In almost majority of patients in this study with characteristic ECG pattern showed disappearance of ECG changes after reperfusion therapy either by PCI or by coronary artery bypass grafting. The identification of this ECG pattern in our hospital warranted importance to such kind of ECG changes. Serial ECG's were recorded before and after reperfusion. It is of great importance that all ECG pattern should be deeply evaluated by ECG operator and consultant cardiologist and immediately refer it for coronary angiogram so that further decision about reperfusion should be carried out to save the myocardium. The subtle but characteristic ECG pattern may be overlooked as presence of ischemia which might delay the reperfusion therapy[11].

The electrophysiological elucidation of the said ECG pattern remains unclear. Patients with this ECG pattern were relatively young, majority of them were males and had high cholesterol level but other risk factors were invariably different. Some of the patients may show poor progression of R-wave and delay in reperfusion with PCI, which suggested that a large area of myocardium is at jeopardy. Theoretically, Purkinje fibres with endocardial conduction hindrance could result in classical distinct ECG pattern. Another explanation could be that the absence of ST segment elevation may be linked to absence of activation of sarcolemmal adenosine triphosphatase sensitive potassium channel by ischemic adenosine triphosphatase and

has been studied in animal models[12].

There is no pervious data available in Pakistan to correlate the distinct ECG pattern with significant lesion in proximal LAD and this study will provide a baseline data regarding reperfusion therapy in future to save the myocardium.

CONCLUSION:

Hyperacute T-waves in the absence of ST-segment elevation has high positive predictive value on ECG and may be indicative of significant disease in LAD. The presence of hyperacute T-waves on ECG may be helpful to make decision about reperfusion therapy.

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