An Observational Study to Identify the Role of ECG in Locating the Occluded Vessel in Patients of Myocardial Infarction with Angiographic Correlation.

Alok Singhal[1], Manas Singhal[2], Vinod Kumar Singh[3]

[1]Associate professor, Department of Medicine, Teerthankar Mahaveer Medical College, TMU, Moradabad.
[2]Ex-Resident, Department of Medicine, Teerthankar Mahaveer Medical College, TMU, Moradabad.
[3]Professor and Head, Department of Medicine, Teerthankar Mahaveer Medical College, TMU, Moradabad.

ABSTRACT

Background: The electrocardiography (ECG) is considered as a fundamental tool in identifying the location and managing the symptoms of acute myocardial infarction. The aim of the present study is to study different ECG patterns according to the vessel involved and then it is correlated with the angiographic findings. **Methods:** It is a prospective and observational study conducted on 50 patients suffering from myocardial infarction with elevated ST segment in ECG who subsequently underwent coronary angiography. Based on the various ECG criteria the vessel involved was recognized and then correlated with angiographic findings. The sensitivity and specificity of individual parameters were calculated. **Results:** The present study demonstrated that ST depression in inferior leads >1mm had maximum sensitivity and specificity in localizing the position of occlusion proximal to S1. Presence of Q wave in aVL had maximum sensitivity and ST depression in the inferior leads showed extreme specificity in patients with occlusion proximal to D1. Presence of Q wave in V4-V6 had 95% specificity and Absence of inferior ST depression presented 89% sensitivity in patients with occlusion in distal S1. Presence of ST depression in aVL showed 98% specificity in patients with distal D1 occlusion. In patients with right coronary artery, ST elevation in LIII>ST elevation in LII and in case of left circumflex occlusion, ST ↑elevation in LII > LIII is the parameter with highest sensitivity and specificity. **Conclusion:** The ECG in patients with ST elevation myocardial infarction is important not only for defining which patient should receive early reperfusion treatment, but also for deciding the site and degree of acute myocardial injury.

Keywords: Angiography, Electrocardiography, Myocardial infarction, Vessel.

INTRODUCTION

In developing countries like India, the cardiovascular diseases (CVD) have become the foremost cause of death. According to the latest survey, cardiovascular diseases have emerged as an epidemic worldwide. The CVD is responsible for 30 per cent mortalities in developed countries and 80% mortalities in developing countries annually. It has been reported that among CVD, acute myocardial infarction (AMI) is responsible for 42% of early mortalities (within 30 days).

Name & Address of Corresponding Author
Dr. Alok Singhal
Associate professor,
Department of Medicine,
Teerthankar Mahaveer Medical College,
TMU, Moradabad.

The main reason behind this is found, the delay in making diagnosis and medical intervention. According to some studies, 1 out of every 30 patient

of AMI dies because of above reason. Besides this, it has been found that the rate of mortality is four times higher in patients above 50 years as compared to younger patients.[1,2]

The electrocardiography (ECG) is considered as a fundamental tool in identifying the location and managing the acute myocardial infarction. In rural areas, clinical symptoms, laboratory parameters and ECG (12 lead) are important parameters in making the diagnosis of acute MI. Because of the simplicity in the procedure of ECG, it is also recommended as the screening method for the identification of disease in developing countries.[3,4]

The patients of AMI are divided on the basis of area of myocardium (anterior, inferior, lateral) involved and ST deviation. The treatment protocol depends on the ST-segment elevation pattern which effects the decision about the perfusion therapy. The identification of the vessel involved in infarction will help in knowing the area of the heart involved and in making the decision regarding the need and firmness of revascularization. ECG also helps in deciding the

prognosis of the disease by studying the ECG signs of reperfusion which helps in knowing the amount of micro vascular blood flow. Electrocardiography imitates the electrophysiology of myocardium during acute ischemia whereas the coronary angiography recognises the vessel structure.[5,6]

The aim of the present study is to study different ECG patterns according to the vessel involved and then it is correlated with the angiographic findings. This comparative study in between ECG and angiography findings will help in knowing the sensitivity and specificity of the ECG findings which will help in making the diagnosis of disease and helps in planning the treatment in rural areas where there are limitations in medical facilities.

MATERIALS AND METHODS

This is a prospective and observational study conducted in department of Medicine in Teerthankar Mahaveer Medical College, Moradabad for the period of two years. The study was conducted on 50 patients with acute myocardial infarction who attended the medical intensive care with elevated ST segment in ECG who subsequently underwent coronary angiography. The written consent was taken from the patients and they were informed about the study.

Inclusion Criteria: a) Patients presenting with chest pain lasting >30 minutes, b) ECG showing ST elevation >1 mm in at least two leads in limb leads & >2 mm in chest leads.

Exclusion Criteria: a) Patients with history of previous myocardial infarction, b) patient with any type of congenital heart disease.

A detailed history was taken about the chest pain, presence of risk factors and duration of risk factors as appropriate. The following tests were done in patients presenting with chest pain a) Standard 12 lead ECG b) Cardiac enzymes (CK and CK-MB or Troponins). Acute myocardial infarction was differentiated on the basis of various ECG criteria and the vessel involved was recognized. Coronary angiography reports were collected. The infarct related artery (IRA) was identified from total occlusion or significant stenosis (>70%).

Statistical Analysis: All data was collected on Microsoft excel sheet and represented in form of Mean ± Standard Deviation. The ECG findings in the patients with anterior and inferior wall were compared using the SPSS 16 software. A P-value <0.05 was considered statistically significant. The sensitivity and specificity of individual parameters were calculated.

RESULTS

The study was done on 50 patients who presented with the severe chest pain. Out of 50 patients, 35 had anterior wall myocardial infarction (AWMI) and 15 had inferior wall myocardial infarction (IWMI) [Table 1].

Table 1: Distribution of patients on the basis of wall involved.

Area involved	Number of patients (n)	Per cent (%)
Anterior wall	35	70
Inferior wall	15	30

Table 2: Distribution of patients on the basis of site of occlusion in patients of AWMI.

Site of occlusion	Number of patients (n)	Per cent (%)
Proximal to S1	15	42.8
Distal to S1	5	14.2
Proximal to D1	12	34.2
Distal to D1	3	8.5

Out of 35 patients with AWMI, 42.8% patients had block proximal to S1, followed by 34.2% had block proximal to D1. The patients with block distal to S1 and D1 are 5 and 3 respectively [Table 2].

The figure 1 represents the various ECG parameters present in different number of patients in occlusion proximal to S1 in AWMI.

ST Elevation in Lead V1 >2.5mm is seen in 10 patients out of 15 with occlusion proximal to S1 and in 4 of the patients with other sites of occlusion. Sensitivity-54%, specificity-88.1%.

Complete Right Bundle Branch Block is seen in 5 out of 15 patients with occlusion proximal to S1 and 1 patient with other sites of occlusion. Sensitivity-12%, Specificity-90.31%.

ST Elevation in Lead aVR: Seen in 7 out of 15 patients with occlusion proximal to S1 and 2 of those with other sites of occlusion. Sensitivity-42%, Specificity-85.56%.

ST Depression in Lead V5: Seen in 2 out of 15 patients with occlusion proximal to S1 and 1 of those with other sites of occlusion. Sensitivity-19%. Specificity-90.5%.

ST Depression in Inferior Leads >1.0mm: Seen in 14 out of 15 patients with occlusion proximal to S1 and 6 of those with other sites of occlusion. Sensitivity–86%, Specificity–90.7%.

Out of 15 patients with IWMI, 5 patients had culprit lesions localized to proximal RCA, 8 in distal RCA and 2 patients in Left circumflex artery [Table 4].
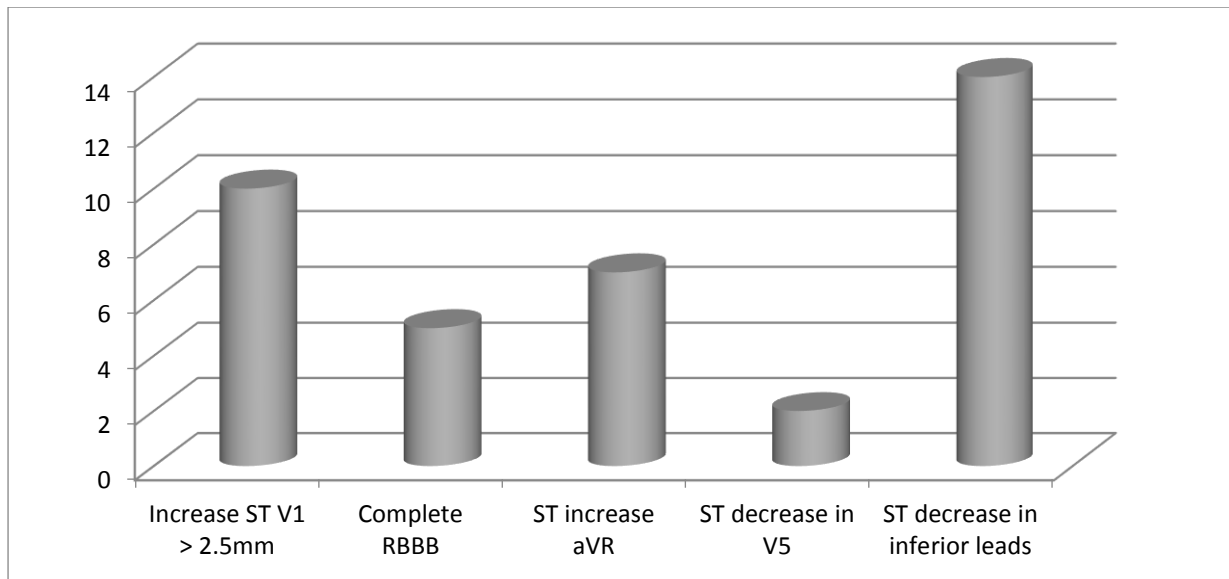
Figure 1: Graph representing the comparison among various criteria for sites of occlusion proximal to S1 in AWMI.

Table 3: Comparison of various criteria to identify culprit vessel in AWMI with present study.

Criteria	Present study		Manjunath et al		Engelen et al	
	Sensitivity	Specificity	Sensitivity	Specificity	Sensitivity	Specificity
Proximal to S1						
ST ↑ V1>2.5mm	54	88.1	71	66	12	100
ST ↑ aVR	42	85.5	50	100	43	95
Complete RBBB	12	90.3	-	-	-	-
ST ↓ V5	19	90.5	8	100	17	98
Inferior ST↓>1mm	86	90.7	90	85	49	85
Proximal to D1						
Q aVL	45	80	66	90	44	85
Inferior ST↓>1mm	36	91	82	90	51	86
Distal to S1						
Q wave V4-V6	25	95	25	88	24	93
Absent inferiorST↓	89	46	93	79	48	83
Distal to D1						
ST↓aVL	15	98	10	100	22	95
Absent inferiorST↓	69	47	82	89	50	86

Table 4: Distribution of patients on the basis of site of occlusion in patients of IWMI.

Site of occlusion	Number of patients (n)	Per cent (%)
Proximal to right coronary artery	5	33.3
Distal to right coronary artery	8	53.3
Left circumflex artery	2	13.3

Table 5: Comparison of various criteria to identify culprit vessel in IWMI with present study.

Criteria	Present study		Glancy et al	
	Sensitivity	Specificity	Sensitivity	Specificity
ECG criteria for RCA occlusion				
ST↑ LIII>ST↑L II	85	75	96	40
ST ↓ LI, aVL	79	71	100	60
ST ↑V4R > 1mm	69	62	86	100
ECG criteria for Left circumflex occlusion				
ST ↑ LII > LIII	70	90	40	96
Isoelectric or ST↑ I, aVL	52	82	60	100

DISCUSSION

Angiography is considered as the gold standard for diagnosing the vessel which is blocked in myocardial infarction.[7] But since angiography is an expensive technique which requires expert doctors, so this method cannot be used in rural areas. Thus this study was conducted to compare the results of ECG with angiography to diagnose the effected vessels.

The study was conducted on 50 patients out of which 39 were males and 11 were females. In a similar study the ratio of Coronary Artery Disease (CAD) in both the genders was about 4:1 in males and

females.[8] In another study done in Washington State determined that Coronary Artery Disease is an effective equal killer in men and women over their lifetimes.[9] Another researcher conducted a study on 12000 patients and followed them for 26 years. In this study it was found that CAD morbidity was twice as high in men as in women, and 60 per cent of coronary events occurred in men.[10] The only limitation of our study was that the number of subjects in our study was only fifty.

In the present study the most common age group involved in myocardial infarction was 45 to 55 years. In a related study done in developed countries like Japan, the most prevalent age group was 50-59 years.[11] The mean age of patients was 58.6 years found in The CREATE-ECLA Randomized Controlled Trial which were as nearly same to this study.[6] Thus we conclude that age is the most important risk factor for atherosclerosis which can lead to various cardiovascular diseases.

Various studies[12-14] recommend that the most important factors which contribute to the disease are hypertension followed by smoking. In this study we found that hypertension accounts for the disease in 54.6% of patients followed by smoking in 39% and dyslipidaemia in 20.7% of patients. Smoking is an essential amendable risk factor. The frequency of smoking is increasing in India. Our study showed that smoking (39%) was one of the most important threat associated with CAD.

In subjects with myocardial infarction (anterior wall) the ECG was compared with the angiography to analyse the results and to identify the involved vessel. Maximum of our findings were comparable with the study done by Kontos et al. In confining the involved vessel proximal to S1, five measures were equated. The present study demonstrated that ST depression in inferior leads >1mm had maximum sensitivity and specificity in localizing the position of occlusion proximal to S1. Presence of Q wave in aVL had maximum sensitivity and ST depression in the inferior leads showed extreme specificity in patients with occlusion proximal to D1. Presence of Q wave in V4-V6 had 95% specificity and Absence of inferior ST depression presented 89% sensitivity in patients with occlusion in distal S1. Presence of ST depression in aVL showed 98% specificity in patients with distal D1 occlusion.

In 15 patients with inferior MI, the involved vessel was right coronary artery in 13 subjects (5 and 8 proximal and distal respectively) and left circumflex artery in the LCX in only two patients. Thus, it was concluded that the right coronary artery is much more likely to be involved than the Left Circumflex artery.

In patients with right coronary artery, ST elevation in LIII>ST elevation in LII had the sensitivity and specificity of 85% and 75% respectively, which was highest as compared to other parameters. In case of left circumflex occlusion, ST ↑elevation in LII > LIII is the parameter with highest sensitivity of 70% and specificity of 90%. These findings were similar to Huey et al.[16]

CONCLUSION

The ECG in patients with ST elevation myocardial infarction is important not only for defining which patient should receive early reperfusion treatment, but also for deciding the site and degree of acute myocardial injury.

By reflecting the pathophysiology of the myocardium during acute ischemia important information to guide management and determine prognosis can be derived from the electrocardiogram. The different criteria of ECG at different locations do not substitute the invasive, but provides a cheaper, consistent and rapid method of differentiating infarct related artery in acute inferior myocardial infarction.

REFERENCES

1. Knopp RH, Zhu X, Bonet B. Effect of estrogens on lipoprotein metabolism and cardiovascular disease in women. Atherosclerosis 1994; 110(Supple): 83-89.
2. Schnohr P, Jensen JS, Scharling G. Coronary heart disease risk factors ranked by importance for the individual and community: A 21 year follow-up of 21000 men and women from The Copenhagen City Heart Study. Europ Heart J 2002; 23: 620-93.
3. Kannel WB, McGee DL. Diabetes and glucose tolerance as risk factor for cardiovascular disease. The Framinghan Study. Diabetes Care 1979; 2: 120.
4. Hadjahj S, Coisnet D, Mauco G, Ragot S, Duengler F, Sosner P, et al. Prognostic value of admission plasma glucose and HbAlc in acute myocardial infarction. Diabetic Medicine 2004; 21: 305-310.
5. Yusuf S, Hawken S, Ounpuu S, Dans T, Avezum A, Lanas F, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study):case-control study. Lancet 2004; 364: 937-952.
6. The CREATE-ECLA Trial Group Investigators. Effect of glucose-Insulin-Potassium Infusion on Mortality in patients With Acute ST-Segment Elevation Myocardial Infarction: The CREATE-ECLA Randomized Controlled Trial. JAMA 2005; 293: 437-491.
7. Kanitz MG, Giovannucci SJ, Jones JS, Mott M. Myocardial infarction in young adults: Risks factors and clinical features. Journal of Emergency Med 1999; 14: 139-145
8. Miller GJ, Beckles BLA, Maude GD, Carson DC, Alexis SD, Prince SGL, Byam NTA, et al. Ethnicity and other characteristics predictive of CHD in a developing community. Principal results of the St. James survey, Trinidad. Int J Epidemic 1989; 18: 808-17.
9. Birnbaum Y, Wagner GS, Barbash GI, Gates K, Criger DA, Sclarovsky S, et al. Correlation of angiographic findings and right (V1 to V3) versus left (V4 to V6) precordial ST-segment depression in inferior wall acute myocardial infarction. Am J Cardiol, 1999; 83:143–148.
10. Gupta A, Lokhandwala YY, Kerkar PG, Vora AM. Electrocardiographic differentiation between right coronary and left circumflex coronary arterial occlusion in isolated inferior wall myocardial infarction. Indian Heart J 1999; 51: 281–284.

11. Zimetbaum PJ, Krishnan S, Gold A, Carrozza JP, Josephson ME. Usefulness of ST-segment elevation in lead III exceeding that of lead II for identifying the location of the totally occluded coronary artery in inferior wall myocardial infarction. Am J Cardiol 1998; 81: 918–919.

12. Lew AS, Laramee P, Shah PK, Maddahi J, Peter T, Ganz W et al. Ratio of ST-segment depression in lead V2 to ST-segment elevation in lead aVF in evolving inferior acute myocardial infarction: an aid to the early recognition of right ventricular ischemia. Am J Cardiol 1986; 57: 1047–105.

13. Radhakrishnan N, Glancy DL. ECG Discrimination between right and left circumflex coronary arterial occlusion in patients with acute inferior myocardial infarction. Chest.2002; 122: 134-139.

14. Bailey CN, Shah PK, Lew AS, Hulse S. Electrocardiographic differentiation of occlusion of the left circumflex versus the right coronary artery as a cause of inferior acute myocardial infarction. Am J Cardiol.1987; 60: 456–459.

15. Kontos MC, Desai PV, Jesse RL, Ornato JP. Usefulness of the admission electrocardiogram for identifying the infarct-related artery in inferior wall acute myocardial infarction. Am J Cardiol 1997; 79: 182–184.

16. Huey BL, Beller GA, Kaiser DL, Gibson RS. A comprehensive analysis of myocardial infarction due to left circumflex artery occlusion: comparison with infarction due to right coronary artery and left anterior descending artery occlusion. J Am Coll Cardiol 1988; 12: 1156–1166.