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Cardiology

ANGIOGRAPHIC CORRELATION OF ST ELEVATION IN LEAD aVR DURNG TMT IN PATIENTS WITH LMCA DISEASE

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ABSTRACT

BACKGROUND: Treadmill testing is the most widely used method for evaluating patients with coronary artery disease. Predicting the left main coronary artery disease (LMCA) before invasive procedure is important in risk assessment because of its grave clinical outcome. Lead aVR can be very useful in identifying LMCA obstruction. It is also valuable lead not only in diagnosis but also predicting the prognosis.

AIM: To examine whether ST elevation in aVR during TMT correlates with LMCA disease in coronary Angiogram

METHOD: In this study 100 patients with positive TMT were included. The study group consisted of 60 patients with ST elevation of > 1mm in aVR. 40 patients also have TMT positive but with < 1mm of ST elevation in aVR is the control group. All patients underwent coronary angiography.

RESULTS: Coronary Angiography in the study group revealed significant LMCA disease in 36 (63%) patients whereas no LMCA disease in control group 12 (20%) patients had ostioproximal LAD leisions in study group 4 (10%) patients in the control group. Triple vessel disease in 10 (17%) patients in study group 6 (15%) patients in control group. Since the p value was significant, ST Elevation in aVR during TMT strongly predicts the presence of LMCA Disease.

CONCLUSION: ST segment elevation in aVR > 1mm during Treadmill testing is a strong predictor of LMCA disease.

KEYWORDS : Tread Mill Test, Left Main Coronary Artery, Lead aVR, ST Segment Elevation.

1. INTRODUCTION:

TMT is a non-invasive test to detect coronary artery disease. It is easy to administer, perform, interpret, physiological, adaptable, flexible, reliable and inexpensive. It differs according to age, sex, heredity, exercise habits, cardiovascular status. TMT has got so many limitations. Inspite of these limitations, TMT strong positive is an important marker of disease burden of coronary arteries. During TMT the ST segment and T wave changes, arrhythmias and decrease in blood pressure may indicate myocardial ischaemia. The ST segment elevation in leads, reflecting the ischaemic region of the heart, demonstrates significant stenosis in the coronary artery supplying this region.

The lead aVR is infrequently used in clinical practice because it is the reciprocal lead of the basal interventricular septum; aVR is affected by perfusion changes of this region. The augmented limb leads were developed to derive more localized information than the bipolar leads I, II, III could offer. For this purpose from the existing limb electrodes, new leads aVR, aVR, aVR were constructed being the unipolar leads at the right, left and lower part of the heart with the reference electrode constructed from the other limb electrodes. Thus the purpose of lead aVR was to obtain specific information from the right upper side of the heart, such as the outflow tract of the right ventricle and the basal part of septum. In practice however most electrocardiograhers consider lead aVR as giving reciprocal information from the left lateral side being already covered by leads aVL, II, V5, V6. This has been the reason why lead aVR is largely ignored.

Lead aVR can be very useful in identifying left main coronary artery (LMCA) obstruction. Ischaemia of the basal part of the interventricular septum is electrocardiographic explanation for the occurrence of ST segment elevation in this lead. In this situation owing to the dominance of the basal ventricular mass the ST- segment vector in the frontal plane points in a superior direction leading to ST segment elevation in leads aVR and ST depression in inferior leads. Lead aVR also helps in differentiating between LMCA and proximal left anterior descending artery (LAD) disease. ST elevation in aVR more than in V1 is suggestive of LMCA disease and vice versa is suggestive of proximal LAD disease. Likewise Engelen et al reported that ST elevation in lead aVR during the acute phase of anterior wall myocardial infarction indicates left anterior descending artery (LAD) Occlusion before the first septal branch.

Other studies have also revealed that ST segment elevation in lead aVR may identify patients with left main coronary artery (LMCA) disease, ST segment depression in aVR is a sign of reduced (35 %) ejection fraction and that ST elevation in aVR is associated with increased in hospital mortality rates among non ST elevation MI patients. Nevertheless there are insufficient data concerning TMT role and the aVR assessment in predicting severity of CAD. In this study we hypothesized that ST segment elevation in lead aVR is a sign for LMCA disease in TMT Positive patients.

2. METHODS:

2.1 Study Design: This is a prospective observational study.

2.2 Study Place: It was done in Department of Cardiology, Rajiv Gandhi Government General Hospital, Chennai, during the period January 2016 to Dec 2016.

2.3 Participants: 700 patients with effort angina from OPD were subjected to TMT. All patients gave written informed consent before inclusion and this study had the approval of our local ethical committee. Participants underwent complete history and physical examination, resting ECG, Transthoracic echocardiography, and measurement of serum cholesterol and blood glucose levels.350 patients had TMT strong positive according to SELZER criteria. Among the 350 patients we included 50 patients who had ST Segment elevation of more than 1 mm in aVR and positivity in TMT as study group (aVR group) .50 age matched patients who had positivity in TMT with less than 1 mm elevation in aVR lead served as control group. They were subjected to coronary angiogram and the angiographic profiles of these 100 patients were studied.

2.4 Protocol: Bruce protocol

2.4.1 Inclusion Criteria- Patients with effort angina class 2 who attended OPD between Jan 2016 to Dec 2016

2.4.2 Exclusion Criteria

• Acute myocardial infarction within two days
• High risk unstable angina
• Uncontrolled cardiac arrhythmias and hemodynamic compromise
• Active endocarditis
• Symptomatic severe Aortic stenosis/Moderate Aortic stenosis with uncertain symptoms
• Decompensated heart failure
• Acute Pulmonary embolism
• Acute myocarditis or Pericarditis
• Physical disability precluding safe and adequate testing
• Known left main disease
• Acquired complete heart block
• HCM with severe resting gradient
• Mental impairment with limited ability to co operate

2.4.3 Patient Preparation:

• Patient should refrain from food, alcohol, caffeine, tobacco products within 3 hours of testing
• Avoid exertion on the day of testing
• Free clothing and 1 male attender,
• List of medications to be noted
• Preparation of chest parts

2.4.5 Termination Of Exercise:

• Acute MI	• Severe shortness of breath
• Onset of moderate to severe angina	• Features of poor perfusion
• Decrease in systolic BP	• Technical inability to monitor ECG
• Serious arrhythmias	• Patients request

2.4.6 Coronary Angiogram: TMT strong positive patients underwent coronary angiogram and angiographic profile was correlated with the ECG changes.

3. RESULTS:

Table 1. Clinical And Demographic Characteristics Of The Avr Group And Control Group

S. NO	PARAMETER	AVR GROUP, N=60	CONTROL GROUP, N=40	P VALUE
1	Age	44 – 78 Yrs.	47 – 76 yrs.	1.000
2	Sex	M= 52, F=8	M= 28, F=12	0.149
3	Effort angina	60	40	1.000
4	Past H/O MI	0	0	-
5	Past H/O CAD	0	0	-
6	Diabetes mellitus	48	34	0.652
7	Hypertension	40	24	0.630
8	Hypercholesterolemia	50	30	0.470
9	Smoking	38	24	1.000
10	ST segment elevation in aVR	2-4 mm	< 1mm	-
11	LMCA disease	38	0	<0.001
12	Ostioproximal LAD disease	12	4	1.000
13	LCX disease	0	14	<0.001
14	RCA disease	0	16	<0.001
15	Triple vessel disease	10	6	0.875
16	SVD	50	34	0.875
17	DVD	0	0	1.000

Table 1 shows that total number of patients included in the study were 100, 60 in study group and 40 in control group in the range of 44- 78 yrs. In study group male-52, female -8 and in control group male -28 and female – 12.History of effort angina was present in all 100 patients.

Coronary angiography in the study group revealed significant LMCA Disease in 38 patients (63 %) whereas no LMCA disease in control group. 12 patients (20 %) had ostioproximal LAD disease in study group , 4 patients (10 %) in control group.Triple vessel disease in 10 patients(17 %)in study group and 6 patients (15 %) in the control group. Significant "p "value (< 0.001) indicates ST segment elevation in lead aVR during TMT strongly predicts the presence of LMCA disease.

4. DISCUSSIONS:

Our study demonstrates the elevation of ST segment in lead aVR may indicate the presence of LMCA disease with high sensitivity and specificity. Lead aVR of a standard 1 lead ECG depicts changes in electrical activation of the upper right part of the heart including right ventricular outflow tract and the basal part of interventricular septum.

In the presence of LMCA or proximal LAD stenosis especially the basal part of left ventricle is subject to ischaemia. Ischaemia of the basal part results in a superior deviation of net vector in the left ventricle. This finding is reflected in the ECG as elevation of ST segments in leads aVR and V1 and ST segment depression in leads V5 and V6 as well as inferior leads. In contrast to that during LAD disease after the first septal branch there is ischaemia of inferoapical left ventricle. In this case due to the inferior deviation of net vectors segment elevation is present in inferior and V4, V5, V6 leads and ST segment depression in aVR lead.

Rostoff et al reported that assessing the lead aVR in patients with acute coronary syndrome can indicate LMCA disease and that analysing the lead V1 does not improve diagnostic accuracy. In our study similar to their results we observed that ST segment elevation in aVR demonstrated LMCA disease. There is no significant finding in V1 during TMT.

Data from literature suggests that a significant relationship between the amplitude of ST segment elevation in aVR and the presence of hypertension, mean systolic blood pressure, diabetes mellitus, cigarette smoking, male gender and advanced age of patients with first acute MI without ST segment elevation in other leads.

In the study of Rostoff et ai only the incidence of hypertension was significantly higher in patients with LMCA disease than in those without it. The prevalence of hypertension was high in both groups and reached 70% in patients with LMCA disease and in 60 % patients without it.

Michaelisdes et al have shown that during TMT ST elevation in V1 and ST depression in V5 predicted significant LAD stenosis and single vessel disease or significant obstruction of LAD and LCX arteries in our study ST depression in leads V2, V3, V4, V5, and V6 occurred concurrently ST segment elevation in lead aVR

Another study reported that sensitivity of isolated exercise induced ST elevation in aVR in detecting LMCA disease was 85 % ,specificity 50 %,positive predictive value 25.8 % and negative predictive value 94.2 %.Tuna katircibasi et al showed that exercise induced ST segment elevation in Lead aVR had a sensitivity of 92.9 % and a sensitivity of 48.6 % and a ST elevation in aVR accompanied by a ST elevation in V1 had a sensitivity of 85.7 % and a specificity of 81.6 % in predicting LMCA disease. The results of these two studies are similar to our study results. In a separate study Michaelis et al reported that exercise induced ST depression in V5 and concomitant ST elevation in aVR Predicted isolated LAD disease.12 of our patients had had ostioproximal LAD leisions in addition to LMCA disease. Interestingly none of the patients had RCA disease .It has been shown that ST segment elevation in aVR during inferior wall MI is a useful predictor of myocardial reperfusion. There are also data showing that ST segment deviation in lead aVR does not indicate infarct related artery in acute inferior MI.

A study performed by Kasuge et al showed that > 0.5 mm ST elevation in aVR in ACS together with elevated troponin value is a useful predictor of LMCA disease or triple vessel disease .There were no ACS or recent MI in our study population. According to literature ischaemia of the basal part of the interventricular septum causes ST segment elevation in lead aVR.

Owing to the dominance of basal ventricular mass ST segment vector in frontal plane points in superior directions leading to ST segment elevation in lead aVR. Chenniappan et al reports that ST segment elevation of > 1mm in aVR during exercise stress testing predicts LMCA or ostial LAD stenosis.

5. CONCLUSION:

ST segment elevation in the lead aVR of > 1mm during treadmill testing is a strong predictor of LMCA disease

6. Limitations:

This is a case control study with inherent limitation although consecutive patients with ST elevation of more than 1 mm are enrolled. This study is carried out at a tertiary care centre which may lead to selection bias and sample size is also less.

7. Conflict Of Interest

The authors have none to declare

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