The Study of Associations of ECG Changes in Lead aVR and Lead V6 with Acute Coronary Syndrome (ACS)

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ABSTRACT

BACKGROUND
The ECG (Electrocardiogram) lead aVR gives reciprocal data for the aVL, II, V5, and V6 leads. It is frequently ignored, even while reviewing complicated ECGs. The purpose of the study was to evaluate the associations of ECG changes in Lead aVR and Lead V6 with acute coronary syndrome (ACS) and coronary complexity as measured by CAG (coronary angiography) in patients with the ACS.

METHODS
This was a prospective Hospital-based observational study. A sample size of 80 patients was being used and a study was done on patients admitted to Mahatma Gandhi Medical College & Hospital, Jaipur with ACS, for 18 months, as well as on those who met the inclusion criteria.

RESULTS
Of 80 patients enrolled with ACS, the mean age was 60.3500 ± 14.8717 (Mean ± SD). The proportion of patients (72.5 percent) had a history of hypertension, and the prevalence of diabetes in the population was found to be significant. The mean ST elevation in lead aVR of patients was 1.4500 ± 0.6779. The mean ST depression in Lead V6 (Mean ± SD) of patients was 2.1519 ± 0.6063. The mean ST depression in corresponding leads (Mean ± SD) was 2.0375± 0.6303 in patients of ACS. In CAG, 27 (33.8 %) patients had TVD (triple vessel disease), 20 (25.0 %) had DVD (double vessel disease) and 22 (27.5 %) patients had SVD (single-vessel disease). The majority of patients, 46 (57.5 %) had angioplasty, and the distribution of coronary artery bypass graft (CABG) outcomes in the overall population was determined to be significant. ECG changes in leads aVR and V6 correlate with age, lead V1, corresponding leads, troponin levels, and Timi Score (Thrombolysis in Myocardial Infarction). There is a positive association in both leads aVR and V6, and the changes occur concurrently in terms of many parameters, indicating the necessity for additional investigation. The outcomes of our investigation were consistent with the findings of ST-T changes in lead aVR and lead V6.

CONCLUSIONS
ECG changes in leads aVR and V6 are associated with poorer prognosis in ACS. Widespread ST-segment depression and ST-segment elevation in lead aVR during episodes of chest pain may represent diffuse subendocardial ischemia caused by severe coronary artery disease (CAD). Further, when interpreting the 12-lead ECG in clinical practice, physicians should give due consideration to the tracing of lead aVR and lead V6 as it can help in identifying the patients who need more aggressive management.

KEY WORDS
Acute Coronary Syndrome, Electrocardiogram, Lead aVR, Lead V6, ST-Segment Depression and ST-Segment Elevation.
BACKGROUND

Acute coronary syndrome remains the leading cause of mortality and morbidity worldwide. In ACS there is an imbalance between myocardial oxygen demand and blood flow, which may be caused by either an acute reduction of blood supply which is caused by a ruptured atherosclerotic plaque in an epicardial coronary artery. Other causes of ACS include coronary artery spasm and dissection of the aorta.[1]

One of the limbs of the augmented ECG leads is lead aVR. It’s angled to “look” at the heart’s right upper side. It provides reciprocal data for the leads aVL, II, V5, and V6. Even when evaluating complicated ECGs, it is usually ignored. In lead aVR, all waves (P, QRS, and T) are negative as depolarization fades.

The essential step in the diagnosis and risk assessment of ACS is to conduct a 12-lead ECG. In circumstances producing right ventricular overload, S wave patterns were frequently observed. In patients with acute myocardial infarction, the S1 and/or SV6 patterns were also prevalent. A significant S wave in lead I alone or in combination with lead V6 in ECGs of middle-aged and/or older patients is thought to indicate the presence of diseases affecting the pulmonary circulation or the left ventricle of the heart.[2]

Therefore, the importance of lead V6 can’t be denied in the diagnosis of ACS. How do we hypothesize that the evaluation of lead V6 will alone help in the detection of ACS? The results of this study may thus provide ground for further diagnosis & management of patients with ACS.

In people with ACS, ST-segment shifts or changes in lead aVR are well known to be associated with left main and/or triple-vessel disease. When establishing a diagnosis and estimating the risk of ACS using ECGs, however, the aVR lead is frequently missed.[3] To use successful diagnostic and treatment techniques, practical and relevant measures are necessary to determine the existence or absence of severity of CAD. However, data on the connection between ST-segment changes or shifts in lead aVR and coronary complexity as measured by the surgical score is still limited. The purpose of this study was to see if there was a link between ST-segment changes in lead aVR and lead V6 and coronary complexity as measured by CAG in patients of ACS.

METHODS

This was a prospective Hospital-based observational study conducted in the Department of General Medicine and Cardiology at Mahatma Gandhi Medical College and Hospital, Jaipur. The study was carried out on 80 patients admitted to the hospital with ACS for over 18 months. The evaluation included patients with STEMI, ST Depression, and non-ST elevation ACS.

Inclusion Criteria
1. The patients presenting with recent typical chest pain attributed to cardiac ischemia lasting at least 20 min and involving an unstable pattern of pain, including rest pain, new-onset severe or frequent angina (accelerating angina).
2. Patients presenting with recent ECG changes (ST elevation, ST Depression and NSTE ACS).

Exclusion Criteria
1. Prerequisites for evaluating the ST segment on the ECG (LBBB, RBBB, left ventricular hypertrophy, ventricular pacing, ventricular pre-excitation, non-ischemic cardiomyopathy, or antiarrhythmic drugs).
2. The ST-segment elevation is transient or persistent in leads other than aVR and V6.
3. A recent [6-month] PCI or a previous CABG.
   • The study protocol for all procedures was approved by the Mahatma Gandhi Medical College & Hospital’s Institutional Review Board for Ethical Clearance.
   • Written and informed consent was taken from all participants before enrolment into the study.

Statistical Analysis
For statistical analysis, data were analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Data were entered into a Microsoft Excel worksheet and analyzed by frequency, percentage, mean, standard deviation (SD), t-test and chi-square tests.

RESULTS

A total of 80 patients were enrolled in this study. Out of 80 patients with ACS, a maximum of 30.0 % of them were in the age group of 61-70 years, the statistical value of z was found at 0.8917. The value of p was 0.37346. The distribution of sex ratio with male dominance of 73.8 %, about 30.0 % of patients had a family history of ACS while 55.0 % and 20.0 % of patients had a habit of smoking and chewing tobacco respectively.

The distribution of various complications hypertension, diabetes type 2, dyslipidemia, obesity, chronic kidney disease (CKD), cerebrovascular accidents (CVA), sleep & stress disorder and sinus tachycardia were found to be 72.5 %, 36.3 %, 28.8 %, 20.0 %, 5.0 %, 6.3 %, 10.0 %, 73.8 % respectively (Fig 1).
The distribution of left ventricular ejection fraction (LVEF) in 2D-Echo-cardiography: 25 % of patients had mild LVEF, 25.0 % of patients had moderate LVEF, 15.0 % patients had severe LVEF, and 35.0 % patients had normal LVEF.

Regional Wall Motion Abnormalities (RWMA) in 2D-Echocardiography were detected in 86.3 % of patients. The distribution of mechanical complications in 2D Echocardiography observed at 32.5 %, 25.0 % and 17.7 % were found in Mild, Moderate and Severe MR and 25 % of patients had no MR respectively.

In our studies, the CAG study showed TVD, DVD, and CAGB with 33.8 %, 25.0 %, and 27.5 % respectively. Angioplasty was performed in 57.5 % of patients and CAGB was done in 3.8 % of patients.

In the present study, 66.3 % of patients had not shown any complications, 1.3 % of patients had bleeding disorder, 10.0 % of patients had CHF, 11.3 % of patients died, 2.5 % of patients had GI Bleed, 1.3 % of patients had hypokalemia, 5.0 % patients had sepsis and 2.5 % patients had severe anemia. The value of \( z \) was 6.9992. The value of \( p \) was <.00001. The result was significant at \( P < .05 \).

![Figure 2. Distribution of Complications in ACS](image)

<table>
<thead>
<tr>
<th>Number</th>
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<td>Troponin Levels</td>
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<td>5.5901</td>
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Table 2. Distribution of Mean of Troponin Levels in ACS

In a study on the association of ECG changes in the ACS of lead aVR and lead V6 with all parameters (Table 4), the Pearson Correlation Coefficient \( r \) for lead aVR was 0.124 and 0.129 for lead V6. Age was shown to have a positive correlation with lead aVR and lead V6. This study's P-values were 0.275 in lead aVR and 0.255 in lead V6. In lead V1, the Pearson Correlation Coefficient \( r \) was 0.625 in lead aVR and 0.686 in lead V6. Lead V1 had a positive association with lead aVR and lead V6. Lead aVR had a P-value of 0.072 and lead V6 had a P-value of 0.041. In the context of the corresponding leads, the Pearson Correlation Coefficient \( r \) in lead aVR was 0.360, and in lead V6, it was 0.951, indicating a positive correlation. The P-value for lead aVR was 0.001, while the P-value for lead V6 was 0.000. This result was statistically significant. The Pearson Correlation Coefficient \( r \) for troponin levels for lead aVR was 0.311 and for lead V6 was 0.275, with a P-value of 0.005 for lead aVR and 0.014 for lead V6, indicating a statistically significant result. For lead aVR, the Pearson Correlation Coefficient \( r \) had a Timi Score of 0.129, whereas lead V6 had a Timi Score of 0.166. Lead aVR and Lead V6 had a positive association with Timi Score. (See Table 4)

<table>
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<th>Age</th>
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<tr>
<td>Number</td>
<td>Pearson Correlation Coefficient ( r )</td>
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<td>0.129</td>
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<tr>
<td>Number</td>
<td>P-value</td>
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Table 4. Correlation of ECG Changes in ACS of Lead aVR and Lead V6 vs. All Parameters

DISCUSSION

The current study sought to determine the association between ST-segment changes in leads aVR and lead V6 and coronary complexity as measured by CAG in patients with ACS. Although lead aVR changes have been neglected until recent years, it is thought to be the reason that most cardiologists consider that the tracing of lead aVR simply reflects perceptual knowledge from the lateral limb and precordial leads.[4] Clinical and related ECG analyses are required to assess the severity of CAD and to apply effective diagnostic and therapeutic strategies. However, data on the connection between ST-segment alterations or shifts in lead aVR and coronary complexity as measured by the surgical score is currently lacking. In light of the foregoing, however, in the last decade, confirmation specifying the significance of lead aVR in the field of ACS has been growing, and lead aVR has been given recognition in clinical practice.[5] Many studies suggest that ST elevation in lead aVR > V1 is extremely diagnostic of left main disease (LM), with 80 % specificity, 81 % sensitivity and accuracy in distinguishing them from proximal left anterior descending coronary artery (LAD) lesions.[6] Sudden occlusion of the LM artery causes life-threatening hemodynamic worsening and fatal arrhythmias, resulting in a harmful outcome, prompt diagnosis and revascularization with percutaneous coronary intervention (PCI) or CABG is essential in this group of patients.[7]

The prognostic significance of ST-segment elevation in lead aVR in ACS and its relationship with significant stenosis of the LM and TVD has recently been studied.[8] An investigation of the relationship between ST-segment
elevation in lead aVR and the severity of angiographic abnormalities in patients with ACS is done. Careful ECG interpretation is effective in detecting the culprit vessel and the coronary artery occlusion location in STEMI patients, with implications for early risk classification, reperfusion, and treatment plan selection.

In our study out of 80 patients with ACS, 27 (33.8%) had TVD, 20 (25.0%) had DVD and 22 (27.5%) patients had SVD on CAG, while normal coronaries were found in 11 (13.8%) patients and 46 (57.5%) of them had gone through angioplasty, 3 (3.8%) of the patients had undergone for CABG. The value of z was 11.7004 and the value of p was < 0.00001.

The Lead aVR (+) has a high predictive value in patients with UA/NSTEMI and may provide additional prognostic value to the conventional cardiovascular risk factor, especially in low and intermediate-risk individuals. The current study showed that the mean ST elevation in lead aVR (mean ± SD) of patients was found to be 1.4500 ± 0.6779. The mean ST depression in lead V6 (Mean ± SD) of patients was 2.1519 ± 0.6063. The mean of ST depression in corresponding leads (Mean ± SD) of patients was 2.0375± 0.6303. In our study, out of 80 patients, the mean troponin levels (mean ± SD) were 5.0733± 5.5901. In our study, the mean (mean ± SD) of the Timi score distribution was determined to be 5.6500 ± 3.3417.

According to our study, the Pearson Association Coefficient (r) for the correlation of ECG changes in the ACS of lead aVR and lead V6 corresponding in terms of all other parameters age, lead V1, corresponding leads, troponin levels, and Timi score was shown to be positive.

In our study, the comparison of ECG changes of leads aVR and V6 with various parameters was done. We found that there was markedly elevated levels of troponin and Timi score and reduced levels of LVEF, which could lead to heart failure, shock and high mortality. There is a positive correlation in both leads aVR and V6, and the changes running parallel in terms of various parameters, so there is a need for further evaluation. Our study findings are consistent with the ST-T changes in leads aVR and lead V6 correlated with grave prognosis and these ECG changes should be seen in every ACS patient for risk stratification.

CONCLUSIONS

ECG is the first step in the evaluation of ACS and its correct interpretation is important for the management of ACS. ECG changes in leads aVR and V6 are associated with poorer prognosis. Widespread ST-segment elevation and ST-segment depression in lead aVR during episodes of chest pain may represent diffuse subendocardial ischemia caused by severe CAD. In this study, the findings showed a positive association in both leads aVR and V6, and the changes occurred concurrently in terms of markedly raised levels of troponin and andTimi scores and reduced LVEF, which could lead to heart failure and shock. These findings are suggestive of grave prognosis and high mortality. The outcomes of our investigation are consistent with the findings of ST-T changes in lead aVR and lead V6. Further research on larger sample size is needed to corroborate the findings of this study. When interpreting the 12-lead ECG in clinical practice, physicians should give due consideration to tracing the lead aVR and lead V6 as they can help identify patients who need more aggressive management.

REFERENCES