Original Article

ST-SEGMENT DEPRESSION IN LEAD AVR CAN PREDICT CULPRIT ARTERY IN ACUTE INFERIOR WALL MYOCARDIAL INFARCTION

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ABSTRACT

OBJECTIVE :To determine the diagnostic accuracy of ST-segment depression in lead aVR for prediction of Left Circumflex artery (LCx artery) as infarct related artery (IRA) in patients having acute inferior wall ST elevation myocardial infarction (STEMI) using coronary angiography as gold standard.

METHODS: The study was conducted at Punjab Institute of Cardiology, Lahore from June, 2012 to December, 2012. All consecutive patients admitted with the diagnosis of acute inferior wall myocardial infarction (IWMI) and their coronary angiographies performed during same admission were studied. The ECG and angiographic findings were then correlated to establish the predictive value of ST depression in aVR in determining the IRA in the setting of acute inferior wall STEMI.

RESULTS: A total of 170 patients, 133 (78.2%) men and 37 (21.8%) women, were studied. Age of the patients was between 30and 70 years. STD in aVR was noted in 98 patients; among these left circumflex coronary artery was the IRA in 55 (56.1%) and RCA in 43 (43.9%). Sensitivity, specificity, positive predictive value and negative predictive value of STD in aVR for diagnosis of LCx artery as IRA were 80.88%, 57.84%, 56.12% and 81.94% respectively.

CONCLUSIONS: ST-depression in aVR can be used for predicting LCx artery as IRA in acute inferior wall STEMI with >80 % sensitivity and negative predictive value.

KEY WORDS: Inferior wall myocardial infarction, ST-depression in aVR, infarct-related artery.

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INTRODUCTION

Acute inferior wall myocardial infarction (IWMI), which accounts for 40-50% of all acute myocardial infarctions (AMI), can be due to sudden occlusion of the right coronary artery (RCA) in 80% of patients followed by the left circumflex coronary artery (LCx) in 20% and rarely left anterior descending artery (LAD) [1]. Mortality and morbidity from acute IWMI are determined, among other factors, by the infarct-related artery.

The poor outcome in IWMI is most often attributed to RCA as the culprit artery particularly in terms of right ventricular infarct [2], increased incidence of shock and rhythm disturbances including atrio-ventricular blocks[3] and consequent high mortality. However, little was known about the clinical presentation, specific complications and possible outcome of patients with LCx artery related AMI till recent past. This may be due to relatively lower incidence LCx artery related ST-elevation MI (STEMI) i.e., 7.5-14.8% of all STEMI4, or because it was subjectively viewed as having more favorable clinical outcome. Some recent studies have shown that LCx artery related acute IWMI may also end up with unfavorable prognosis. The 30 day mortality in ASSENT[4] IWMI trial was found to be significantly higher among patients with infarction in the LCx artery distribution[5]. Rasoul et al[6], reported that lower left ventricular ejection fraction (LVEF<45%) was more frequently seen in LCx artery related infarcts (37%) as compared to RCA infarcts (26%), p < 0.0, portending worse prognosis. Moreover, prevalence of advanced congestive heart failure (CHF) and acute respiratory failure has been shown to be higher in LCx artery related AIW-STEMI than RCA related AIW-STEMI in patients undergoing primary PCI (percutaneous coronary intervention) and so is 30 day mortality.[7] One possible explanation of this worse outcome is that the patients with LCx artery related AMI have angiographically documented less well developed collateral circulation.[7]

Early identification of the infarct related artery (IRA) in patients with IWMI may influence and guide the reperfusion strategy in the current era of primary PCI. Although coronary angiography is the

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gold standard for determining IRA in acute MI, the electrocardiography (ECG) can be a useful tool in identifying which artery is involved at the first point of care. The ECG is rapid, non-invasive, affordable and easy and essentially without any adverse effects, so it can be used for early identification of IRA to predict the amount of myocardium at risk and guide decisions regarding the urgency of revascularization.

Considering this, several ECG criteria have been put forward in last two decades to differentiate between RCA and LCx artery as the culprit vessel. Previous studies have established that classical criteria including: ST-elevation in I, ST-segment elevation in lead II> lead III, ST depression in lead V1 & V2 and ST-segment depression in V3> ST elevation in III were useful in predicting LCx artery as IRA[8]. Recently a new criterion i.e., ST-segment depression in aVR, has been analyzed in few studies and found to predict the LCx artery involvement in acute IWMI with greater accuracy as compared to the conventional criteria[9,10]. This criterion was found to be 70% specific and 94.3% sensitive for predicting LCx artery as IRA .

Lead aVR is a generally neglected area of ECG evaluation. It can, however, provide important information in certain situations and one such situation is acute inferior wall myocardial infarction where it may predict IRA. The purpose of this study was to evaluate the diagnostic value of ST-depression in aVR for predicting LCx artery as IRA in patients having acute IWMI.

Table 1: Clinical and Angiographic Characteristics of Patients with and without STD in lead aVR.

Clinical and Angiographic Characteristics		STD in aVR (n = 98)	No STD in aVR (n = 72)	P-value
Age (years)		51.28 ± 10.913	50.81 ± 9.468	0.770
Sex	Male	79 (80.6%)	54(75.0%)	0.381
	Female	19(19.4%)	18(25.0%)	
Diabetes Mellitus		39(39.8%)	30(41.7%)	0.806
Hypertension		53(54.1%)	39(54.2%)	0.991
Smoking		42(42.9%)	36(50.0%)	0.356
Family History of IHD		34(34.7%)	24(33.3%)	0.853
Dyslipidemia		40(40.8%)	23(31.9%)	0.237

Table 2. STD in aVR versus IRA, a 2x2 contingency table.

Variables	LCx artery as IRA	RCA as IRA
ST-depression in aVR present	55	43
ST-depression in aVR absent	13	59

Sensitivity: (55/55+13) x100 = 80.88%
Specificity: (59/59+43) x100 = 57.84%
Positive Predictive Value: (55/55+43) x100 = 56.12%
Negative Predictive Value: (59/59+13) x100 = 81.94%

METHODS:

This cross-sectional study was conducted at Department of Cardiology, Punjab Institute of Cardiology, Lahore, Pakistan from June 2012 to December 2012. Consecutive patients of either gender between 30-70 years of age presenting with acute inferior wall STEMI were selected using non probability purposive sampling technique. Patients having previous history of ischemic heart disease (IHD) including prior MI or previous percutaneous or surgical revascularization, pre-existing right or left bundle branch block on ECG, those not willing for or having any contraindication to coronary angiography and those having significant stenosis of both RCA and LCx artery in the setting of acute IWMI thus making it difficult to find out a single IRA were excluded from the study. Informed consent was taken from all patients. Demographic data and cardiovascular risk factors were recorded. Standard 12 lead ECG was recorded at a speed of 25 mm/s and voltage of 10 mm/mV to assess the presence or absence of ST depression in aVR. Baseline laboratory investigations like Complete Blood Count, Renal Function Tests and CK-MB were done. All the patients underwent coronary angiography during their hospital stay and their angiographic data was assessed to rule out the presence or absence of either >70% stenosis or intra-luminal thrombus in LCx artery. All the information was recorded on a predesigned proforma. The accuracy of ST depression in lead aVR in the diagnosis of LCx artery related acute IWMI was established by taking coronary angiography as gold standard.

DATA ANALYSIS PROCEDURE:

Data was analyzed using SPSS version 20. Quantitative variables like age were expressed as means + SD (standard deviation), while qualitative variables like gender and presence or absence of

angiographic evidence of disease in LCx artery were expressed as frequencies and percentages. A 2x2 contingency table was generated to calculate sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV).

RESULTS:

A total of 170 patients with acute IWMI who underwent coronary angiography and fulfilled the inclusion criteria were studied. Out of 170 patients, 133 (78.2 %) patients were males and 37 (21.8%) were females. Mean age of the study population was 51.08 + 10.3 years (range 30- 70). STD in aVR was observed in 98 patients; among these left circumflex coronary artery was the IRA in 55 (56.1%) and RCA in 43 (43.9%). Among patients with no STD in aVR (n=72), LCx artery was IRA in 13 (18.1%) and RCA in 59 (81.9%), p=0.001. Both groups were comparable with respect to age, gender and coronary risk factors (Table 1). Sensitivity, specificity, positive predictive value and negative predictive value of ST-depression in lead aVR in the diagnosis of LCx artery as IRA were 80.88%, 57.84%, 56.12% and 81.94% respectively.

DISCUSSION:

This single centre observational study revealed that ST-depression in lead aVR is a reliable indicator to identify the LCx artery as IRA in patients presenting with acute IWMI.

The incidence of inferior wall myocardial infarction is lower as compared to that of anterior wall MI (41 % versus 56%). [12] Acute IWMI can be due either to RCA or LCx artery occlusion. The RCA supplies blood mainly to the inferior myocardium, whereas the LCx artery supplies blood to the posterior, posterolateral, or posteroinferior myocardium.[13]

Relative distribution of RCA-related acute IWMI is quite high among the population affected by STEMI while only small percentage of patients with IWMI are attributed to the presence of culprit lesion in LCx artery. Reported incidence of STEMI due to LCx artery occlusion varies; 7.5% - 14.8% in some earlier studies [4, 14] and upto 19.5% in a recent study[7]. Relative distribution of IRA was only 18% for LCx artery versus 37% for LAD and 46% for RCA among 2082 patients undergoing primary PCI for both anterior and inferior acute STEMI cases in the CADILLAC trial.[15] There is more uniform distribution of infarct related arteries among patients with non ST elevation MI (NSTEMI). Out of 30, 386 NSTEMI patients evaluated by American College of Cardiology National Cardiovascular Data Registry (ACC-NCDR), the culprit vessel was LAD in 38%, RCA in 34% and LCx artery in 28%.[16]

In spite of relatively lower incidence, LCx artery-related acute IWMI may be associated with substantially higher incidence of adverse events5. LCx artery-related IWMI independently predicted 30-day mortality in AMI patients undergoing primary PCI. [7]

Patients who experienced dominant LCx artery-related IWMI had higher incidences of advanced CHF, advanced Killip score, unstable condition at presentation, and 30-day mortality than those with non-dominant LCx artery -related STEMI undergoing primary PCI.[14]

Patients with LCx artery related infarct are likely to have larger infarct size (assessed by enzyme elevation) and a lower left ventricular ejection fraction leading to higher mortality at 30 days and at one year.[6]

The present study revealed that among patients with acute IWMI, culprit lesion was in RCA 60% patients and in LCx artery in 40% patients. Relative prevalence of LCx artery related acute IWMI is higher in our study as compared to the prevalence reported in previous studies [4,7,14]. Several ECG findings have been investigated for their possible correlation with IRA in the setting of acute IWMI.[13, 17-22] Based on these studies, two algorithms have been defined by Fiol et al.[23] and Tierala et al[24] to evaluate the culprit artery in acute IWMI. All these criteria predict majority of the RCA lesions with adequate accuracy, however, the IRA cannot be correctly identified by these conventional criteria in a small subset of patients, especially those having LCx artery related STEMI.

The standard 12-lead ECG is, therefore, not sensitive for diagnosing acute occlusions of the LCx artery. Although it is able to diagnose acute occlusion of the LAD and RCA with 85–90% and 70–90% sensitivity, respectively, it is only able to diagnose occlusion of the LCx artery with 32–50% sensitivity.[25,26]

The lack of sensitivity of ECG for detecting LCx artery related infarcts is supported by a study comparing patients with RCA occlusion to LCx artery occlusion, revealing that patients with LCx artery occlusion had larger infarcts and more left ventricular dysfunction, despite having lesser magnitude of ST-segment elevation.[6] The most likely reason is the posterolateral location of LCx artery territory, which is farther from the chest wall, with a lack of corresponding electrocardiographic leads.[27,28] Coronary dominance can also play a role. The prevalence of RCA dominance in the population might be protective for acute occlusions

of the LCx artery territory by providing collaterals or dual supply, minimizing infarct size, and reducing the likelihood of having ST-segment elevation in ECG. Similarly, patients with acute occlusions of a non-dominant, small right coronary artery might not have typical ST-segment elevation on the inferior electrocardiographic leads.[29,30] Significant ST-segment depression in aVR is more likely to be seen with LCx artery occlusion and this can be explained on the basis of an obtuse angle of the current of injury in relation to axis of lead aVR. [11]

The same is highlighted by findings of our study in terms of diagnostic value of this ECG parameter: sensitivity of 80.88%, specificity of 57.84%, PPV of 56.12% and NPV of 81.94%. The sensitivity from our study is higher and specificity lower than that reported by Sun et al[11] (70% sensitivity and 94.3% specificity). Contrary to our study, Kanei et al.[9] have demonstrated lower sensitivity (53%) but a higher specificity (86%) for the same criterion of ST-depression in aVR for predicting LCx artery related infarct in patients with IWMI.

In conclusion, ST -depression in aVR may be a useful tool in identifying LCx artery involvement as the IRA in IWMI at the bedside with reliable diagnostic accuracy (more than 80% sensitivity and negative predictive value); coronary angiography, however, remains the gold standard for determining the IRA in acute myocardial infarction.

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