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PREDICTION OF CULPRIT ARTERY IN ST-SEGMENT ELEVATED INFERIOR WALL MYOCARDIAL INFARCTION BY ST-SEGMENT DEPRESSION IN LEAD aVR- A SINGLE CENTRE STUDY

Cardiology

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ABSTRACT

Background & Objective: Various ECG criteria have been suggested to predict the culprit artery in acute inferior MI based on analysis of ST-segment elevation and depression in different leads and importance of ST-segment depression in lead aVR as a sign of LCx occlusion has also been emphasized. The present study was conducted to determine the diagnostic accuracy of ST-segment depression in lead aVR in predicting the culprit artery in ST-elevated inferior myocardial infarction.

Patients & Methods: This cross-sectional study included a total of 116 patients who presented with ST-segment elevated inferior myocardial infarction and were admitted in CCU (NHFH&RI) and underwent coronary angiogram during hospitalization. The patients were divided into two groups – Cases having ST-segment depression ≥ 1mm in lead aVR and Controls having no ST-segment depression in lead aVR Diagnosis of culprit artery was made by coronary angiogram. All the baseline characteristics and outcome were then compared between the two groups.

Result: In the present study, 47(40.5%) patients had ST-segment depression ≥ 1 mm in lead aVR and 69(59.5%) patients had no or < 1 mm ST-segment depression in lead aVR. The groups were almost similar in terms of age, sex, BMI, co morbidities/risk factors and duration of chest pain ($p > 0.05$ in each case). The study demonstrated that ST-segment depression in lead aVR in predicting the LCx as culprit artery in acute inferior myocardial infarction had a sensitivity of 89.8% and a specificity of 95.5% with an overall diagnostic accuracy of 93%.

Conclusion: So it can be concluded that ST-segment depression of ≥ 1 mm in lead aVR in inferior wall acute myocardial infarction can predict LCx as the culprit artery with fair degree of accuracy.

KEYWORDS

St Segment Elevation, St Segment Depression, Inferior Myocardial Infarction, Lead Avr, Culprit Artery

INTRODUCTION

Acute myocardial infarction (AMI) is a major component of acute coronary syndrome (ACS) which is usually due to anterior and inferior wall involvement. Unlike anterior wall AMI, which is a fairly homogenous entity, the extent of acute inferior wall MI depends on the infarct related artery and its size. Inferior wall AMI accounts for 40-50% of all AMI and the infarct-related artery can either be the RCA or the Lcx.

The mortality and morbidity of AMI inferior depend on the site of coronary artery lesion. Proximal RCA occlusion in most cases result in RV-infraction which has significantly higher incidence of hypotension, arrhythmia, conduction disturbance and death. LCx occlusion has been associated with a larger infract size and a higher complication rate like atrial fibrillation (AF), cardiogenic shock and death.

ECG information about the culprit artery in inferior myocardial infarction is important because the prognosis and therapeutic strategy may vary between LCx and RCA related inferior myocardial infarction. Early identification of the culprit artery in patients with symptoms of AMI can reduce the time to reperfusion in percutaneous coronary intervention and permit a better risk stratification.

Electrocardiogram can be an useful tool to predict the culprit artery in acute STsegment elevated inferior wall myocardial infarction.This cross -sectional study is directed to find the diagnostic accuracy of ST-segment depression in lead aVR in predicting the culprit artery in ST-elevated inferior myocardial infarction.

An inverted format as lead −aVR (+30°) lies between lead I (0°) and lead II (60°). Thus, aVR depression means −aVR elevation, which represents the infarct of the apical and inferolateral walls, usually supplied by the posterolateral branch of either the RCA or LCx itself.ST-segment depression in lead aVR in inferior wall ST-elevated AMI predicts LCx infarction or RCA infarction involving a large posterolateral branch. Current of injury resulting from occlusion of the LCX has a mean vector that forms an obtuse angle with the axis of aVR thus producing a significant ST segment depression in aVR.

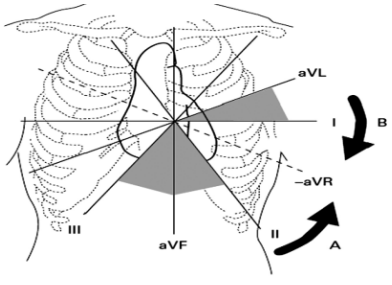

Fig (1): Diagrammatic illustration of ST elevation in lead –aVR. Arrow A indicates more lateral involvement in patients with inferior ST elevation (shadow). Arrow B indicates more inferior involvement in patients with lateral limb lead ST elevation (shadow) (Kanei, et al., 2010)

METHODOLOGY

The present study was a cross sectional study carried out in Department of Cardiology, National Heart Foundation Hospital & Research Institute (NHFH&RI), Dhaka, Bangladesh over a period of one year between April 2013 to March 2014. The study included 116 patients who presented with ST-segment elevated inferior myocardial infarction who got admitted in CCU (NHFHRI). Meticulous history was taken regarding symptoms and detailed clinical examination was performed in each patient.Demographic data such as age, sex, height (cm), weight (Kg), BMI (Kg/m2) were noted.Patients were stratified into 2 groups – who had ST-depression of 1mm or more in lead aVR(n=47) and patients having no ST-segment depression in lead aVR (n=69).Coronary angiogram was performed in all patients within hospitalization period. CAG was analyzed by visual estimation. 70% or more luminal stenosis was considered significant. The interpreters of CAG had no prior knowledge of the ECG status of the patient. The patency of the coronary arteries and in particular of the infarct related artery was tested and documented by the following criteria: a) Total or sub total occlusion of a vessel that perfuses a hypokinetic or asynergic myocardial area. b) Angiographic presence of thrombus or ruptured plaque in that vessel. Culprit lesion or infarct related vessel means

artery that was considered to be caused for MI.If both the RCA and LCx arteries were found diseased, that met exclusion criteria. Only arteries with stenosis of 70% or more were judged as cause of MI.The presence of significant stenosis in major diagonal or marginal branches was considered Left anterior descending or Left circumflex artery respectively.Angiographic variables like infarct-related vessel were compared between two groups to identify in which group LCx is more likely to be the culprit artery.Patients were followed up from their admission in the hospital up to discharge and occurrence of complications, if any were noted.

Patients with history and /or evidence of previous myocardial infarction associated acute anterior myocardial infarction, H/O recent Cerebro Vascular disease. concomitant co-morbid conditions that are not suitable for CAG,patients with factors potentially confounding the E.C.G interpretation-bundle branch block,WPW syndrome,paced rhythm,low voltage E.C.G,patient who don't want to go through coronary angiography,patient who was documented to have lesions in both RCA and LCx after CAG was done were excluded. Prior approval was sought from Ethical Review Committee, National Heart Foundation Hospital & Research Institute, Mirpur, Dhaka to carry out this study. Keeping compliance with Helsinki Declaration for Medical Research Involving Human Subjects 1964, all the subjects were informed about the nature, purpose and procedure of the study and their rights to withdraw themselves from the study at any time, for any reasons, what-so-ever. Informed written consent was obtained from each subject.

Statistics

Data were collected using a structured questionnaire containing all the variables of interest.Using computer software SPSS (Statistical Package for Social Sciences) data were processed and analyzed. The test statistics used to analyze the data were unpaired t-Test and Chi-square ($\chi 2$) Test. The level of significance is 0.05 and p-value < 0.05 was considered significant.

To interpret the accuracy of a screening test against a confirmatory diagnosis, which is considered as the 'Gold Standard'. Following method is used.

Accuracy of a screening test against an established diagnosis

Screening test	Established diagnosis		Total
	+ve	-ve	
+ve	a	b	(a + b)
-ve	c	d	(c + d)
Total	(a + c)	(b + d)	(a + b + c + d)

The following measures were used to evaluate a screening test:

1. Sensitivity = a/(a +c) x 100
2. Specificity = d/(b +d) x100
3. Positive predictive value of the test (PPV) = a/(a +b) x 100
4. Negative predictive value of the test (NPV) = d/(c +d) x 100
5. Percentage of false +ve = b/(a +b) x 100
6. Percentage of false –ve = c/(c +d) x100
7. Diagnostic accuracy = (a + d)/(a + b + c + d) x 100

Here screening test is amplitude of ST-depression in lead aVR and established diagnosis is coronary angiogram.

In the table below, the letter '**a**' denotes those individuals having lead aVR ST-depression of 1mm/more and in CAG infarct related artery is LCx(i.e., true positives),

While '**b**' includes those individuals having lead aVR ST-depression of 1mm/more but in CAG infarct related artery is not LCx (i.e., false positives).

The letter **'c'** is individuals who don't have lead aVR ST-depression of 1mm/more but in CAG infarct related artery is LCx (i.e., false negatives)

And the letter '**d**' number of individuals who don't have lead aVR ST-depression of 1mm/more and also in CAG infarct related artery is not LCx (i.e., true negatives).

Result:

Age distribution between case and control groups was almost identical with mean ages of the case and control groups being 54.3± 11.4 and 54.7± 12.2 years respectively (p = 0.598). The sex distribution was also similar with males being predominant in both the groups (p = 0.251) **(Table I)**

Nearly three-quarters of the case and control groups were current smoker (p = 0.494). Around 45% of both groups were diabetics, 70% were hypertensive and 75% were dyslipidemic. The differences between the groups with respect to these variables were not significant (p > 0.05). Very few had family history ischemic heart diseases. **(Table II)**

LCx was the infarct related artery in majority of cases (93.6%), among the control group, RCA was common as the infarct related artery (92.8%). **(Table III)**

In case group proximal part of the infarct related artery was mainly involved (87.2%), where as in control group 52.2% had lesion in proximal part and 40.6% had in lesion mid part of the infarct related artery. **(Table IV)**

Majority (82.9%) of the case group had LCx involvement and majority (69.6%) of the control group had RCA involvement. A few patients had combined LCX+LAD involvement in case group that was 10.7%, 6.4% of cases had isolated RCA involvement and case group there was no RCA+LAD involvement .In control group majority of patients had RCA involvement that was 69.6%, RCA+LAD was involved in 23.2% of controls, isolated LCx was involved in 7.2%,in control group there were no LCx+LAD involvement. **(Table V)**

In case group in 44 patients LCx was the infarct related artery (true positives) In 3 patients RCA was the infarct related artery (false negatives). In control group, in 5 patients LCx was the infarct related artery (false negatives) and in 64 patients RCA was the infarct related artery (true negatives). **(Table VI)**

The sensitivity of ST-segment depression of 1mm/more in lead aVR in diagnosing LCx as infarct related artery is 89.8% and specificity of the test is 95.5%. The positive and negative predictive values of the diagnostic modality are 93.6% and 95.5% respectively, while the percentages of false positive and false negatives are 6.4% and 10.2% respectively. **(Table VII)**

DISCUSSION

In the present study,47**(**40.5%) patients had ST-segment depression ≥ 1 mm in lead aVR and 69(59.5%) patients had no or < 1 mm ST-segment depression in lead aVR**.** The groups were almost similar in terms of age, sex, BMI, co morbidities/risk factors and duration of chest pain (p > 0.05 in each case). The study demonstrated that ST-segment depression in lead aVR in predicting LCx as the culprit artery in acute inferior myocardial infarction had a sensitivity of 89.8% and a specificity of 95.5% with an overall diagnostic accuracy of 93%.

CONCLUSION

From the findings of the study it can be concluded that ST-segment depression in lead aVR in inferior wall acute myocardial infarction can predict LCx as the culprit artery with fair degree of accuracy. The sensitivity and specificity both were high.

Study limitations

Like any other scientific study, the present study has several limitations, which deserve mention as for it was a single centre study.One of our study limitations was that the size of infarction was not estimated. The second limitation was the study lacked the evaluation of right-sided precordial leads (V4R),and posterior leads which may have further helped to identify the culprit artery in inferior STEMI.All the patients with acute inferior MI were not included due to different contraindications and co-morbid conditions.

Table I. Comparison of demographic variables between case and control groups (N=116)

Demographic variables	Group		p-value
	Case	Control	
Age	(n = 47)	(n = 69)	
<40	6(12.8)	6(8.7)	0.598$^{(NS)}$
40 – 50	27(57.4)	37(53.6)	
>50	14(29.8)	26(37.7)	

Mean ± SD	54.3 ± 11.4	54.7 ± 12.2	
Sex			
Male	43(91.5)	59(85.5)	0.251$^{(NS)}$
Female	4(8.5)	10(14.5)	

Table II. Distribuxotion of risk factors for ischemic heart diseases between groups (N=116)

Risk factors	Group		p-value
Smoking Habit	**Case** (n = 47)	**Control** (n = 69)	
Current	35(74.5)	49(71.0)	0.494$^{(NS)}$
Former	0(0.0)	2(2.9)	
Never	12(25.5)	18(26.1)	
DM	22(46.8)	29(42.0)	0.704$^{(NS)}$
HTN	35(74.5)	46(66.7)	0.369$^{(NS)}$
Dyslipidemia	38(80.9)	49(71.0)	0.230$^{(NS)}$)
Family H/O IHD	2(4.3)	4(5.8)	0.533$^{(NS)}$

Table III. Distribution of infarct-related artery between groups (N=116)

Infarct-related artery	Group	P-value	
	Case (n = 47)	Control (n = 69)	
LCx	44(93.6)	5(7.2)	<0.001^{S}
RCA	3(6.4)	64(92.8)	

Table IV. Site of lesion in infarct-related artery between groups (N=116)

Part of the infarct-related artery involved	Group		P-value
	Case (n = 47)	Control (n = 69)	
Proximal	41(87.2)	36(52.2)	<0.001^{S}
Mid	5(10.7)	28(40.6)	
Distal	1(2.1)	5(7.2)	

Table V. Coronary artery involvement between groups (N=116)

Arteries involved	Group		P-value
	Case (n = 47)	**Control** (n = 69)	
LCX	39(82.9)	5(7.2)	<0.001^{S}
LCX &LAD	5(10.7)	0(0.0)	
RCA	3(6.4)	48(69.6)	
RCA & LAD	0(0.0)	16(23.2)	

Table VI. Distribution of coronary angiographic findings in respect of infarct related artery in case and control groups (N=116)

ST-segment depression in lead aVR of 1mm/more	Infarct related artery in Coronary Angiogram		Total
	Lcx (n = 49)	**RCA** (n = 67)	
Positive(Case)	44(a)	3(b)	47(a+b)
Negative(Control)	5(c)	64(d)	69(c+d)
Total	49(a+c)	67(b+d)	116(a+b+c+d)

Table VII .Diagnostic accuracy of ST-depression of 1mm/more in lead aVR in predicting LCx as infarct-related coronary artery in acute ST-elevated inferior myocardial infraction

Screening Test	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Diagnostic accuracy(%)
Accuracy of ST-depression of 1mm/more in lead aVR in predicting LCx as IRA	89.8	95.5	93.6	95.5	93.1

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