

## Correlation of Severity of ST Segment Elevation with Respect to the Site of Right Coronary Artery Lesion

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### ABSTRACT

**Introduction:** Electrocardiogram a widely available tool may predict infarct related artery in acute inferior wall myocardial infarction. Severity of ST segment elevation may correlate with proximity of lesion in right coronary artery.

**Methods:** Patient with acute ST segment elevation inferior wall myocardial infarction who underwent coronary angiogram was studied. Differences in electrocardiogram among right coronary and left circumflex groups were evaluated. Severity of ST segments elevation in relation to site of lesion in right coronary was studied.

**Results:** The mean age of presentation was  $59.52 \pm 11.01$  years. Total 36 (72%) were men. A total of 42 (84%) had lesion in right and 8 (16%) in left circumflex. Age, sex, diabetes, hypertension, smoking, dyslipidemia and physical activity showed no correlation with lesion in right or circumflex coronary artery. ST segment elevation in III>II ( $P=0.01$ ), ST segment depression in AVL>I ( $P<0.01$ ) and ST elevation in V4R ( $P=0.04$ ), correlated with right coronary lesion. Sum of ST elevation in inferior leads were  $10.90 \pm 1.30$  mm for proximal,  $7.38 \pm 1.19$  mm for mid and  $5.50 \pm 0.53$  mm for distal right coronary with significant correlation ( $P<0.01$ ).

**Conclusions:** Electrocardiogram was reliable tool to difference right and left circumflex lesion. Severity of sum of ST segment elevations in inferior leads correlated with the proximity of lesion in right coronary.

**Keywords:** acute inferior myocardial infarction; electrocardiogram; infarct related artery.

### INTRODUCTION

ST segment elevation myocardial infarction (STEMI) represents the most lethal form of Acute Coronary Syndrome (ACS).<sup>1</sup> About one third of myocardial infarction (MI) are STEMI.<sup>2</sup> Acute inferior STEMI is characterized by ST segment elevation in leads II, III, and aVF. Infarct related artery (IRA) of inferior MI can be right coronary artery (RCA) or left circumflex artery (LCX).<sup>3</sup> RCA supplies several important structures in heart, so they can be involved if IRA is RCA.

Electrocardiogram (ECG) is a simple and easily available tool. Several ECG criteria has been recommended for the IRA prediction with variable results.<sup>4,5</sup> Predicting the site of occlusion in RCA by ECG is worthwhile as proximal occlusion is likely to cause larger myocardial damage.

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The objective of the study was to determine IRA focusing correlation between RCA lesion site and severity of ST segment elevation in inferior leads in inferior MI in our setup.

## METHODS

A cross-sectional prospective study was conducted at Department of Cardiology, Shahid Gangalal National Heart centre (SGNHC) Kathmandu from February to July 2013. Ethical approval was taken from the Institutional Review Board (IRB) of National Academy of Medical Sciences (NAMS) and the informed consent was obtained from all the participants.

All the participants needed to have had coronary angiogram (CAG) done either during the primary percutaneous intervention (PCI) or before discharge from hospital to be included in the study. Patients with previous history of coronary artery disease, with left bundle branch block, a paced rhythm, an accelerated Idioventricular rhythm or severe artifacts causing difficulty for accurate ST segment measurement were excluded. Patients who didn't go angiogram or with diffuse angiographic lesions involving more than one segment in RCA or involving both RCA and LCX were excluded. Patients who didn't give consent for the study were also excluded.

A total of 50 consecutive patients of acute ST segment elevation inferior wall MI were included. Among the patients who presented with clinical features suggestive of MI, acute inferior wall STEMI was diagnosed on the basis of  $\geq 1$  mm ST elevation in at least 2 inferior leads ECG measured 0.08 seconds after the J points with reciprocal ST segment depression in I and aVL and rise of cardiac enzymes (CPK-MB or Troponin I). The patients were evaluated focusing the variables to be tested. Those who practice at least 30 minute of moderate exertional activity each day were considered physically active. ECGs were recorded at 25 mm/s speed, and calibrated to 1 mV/cm. The right sided ECG and posterior ECG was taken in all with the suspicion of RV infarction (ST elevation  $\geq 1$ mm in V4R) and posterior infarction (ST elevation  $\geq 1$ mm in V7-V9) respectively.

The patients were followed up for coronary angiogram. Angiograms were evaluated for IRA as RCA or LCX. RCA, further was categorized in proximal [from ostium to the first Acute Marginal (AM)], mid (from First to last AM) or distal (from last AM onwards).<sup>6</sup> The lesion with highest degree of stenosis was accepted as culprit lesion.

Data were entered and analyzed using SPSS version 14 for windows. For demographic profiles frequencies

and percentage distribution were calculated for each variable. Chi square test were used to detect the level of significance. Means were compared using one way ANOVA. P values were calculated and values less than 0.05 were considered statically significant.

## RESULTS

Among the 50 enrolled patients of acute inferior wall MI, majority 36 (72%) were male. The age ranged between 33 to 82 years with mean age of presentation being  $59.52 \pm 11.01$  years. Hypertension and diabetes were present in 20 (40%) and 13 (26%) respectively. A total of 19 (38%) were current smoker (Table 1).

**Table 1. Baseline characteristics of enrolled subjects.**

Characteristics	Values
Age ( mean $\pm$ SD)	59.52 $\pm$ 11.01 years
Age Range	33 – 82 years
Sex male : female, No.(%)	36 : 14 (72% : 28%)
Hypertension, No.(%)	20 (40%)
Diabetes, No.(%)	13 (26%)
Smoker, No. (%)	19 (38%)
Dyslipidemia, No. (%)	9 (18%)
Physically inactive, No. (%)	21 (42%)

Different forms of bradyarrhythmia were prevalent among the participants. A total of 16 (32%) had sinus bradycardia, 5 (10%) had complete heart block. Right sided and posterior ECG revealed 15 (30%) ST elevation in V4R and 8 (16%) ST elevation V7-V9 leads (Table 2).

**Table 2. Common complications noted in study subjects.**

Title	N (%)
Sinus Bradycardia	16 (32%)
Complete Heart block	5 (10%)
2 <sup>nd</sup> degree AV block	3 (6%)
ST $\uparrow$ V4R	15 (30%)
ST $\uparrow$ V7-V9	8 (16%)

A total of 42 (84%) subjects had lesion in RCA and 8 (16%) had lesion in LCX.

There was no significant difference in the baseline characteristics between the RCA and LCX group. Age, sex, presence of diabetes and hypertension, smoking, known dyslipidemia and physical activity status showed no correlation to lesion in right or left circumflex coronary artery (Table 3).

**Table 3. Comparison of baseline characteristics in relation to RCA Vs. LCX.**

Characteristics	RCA (No. = 42)	LCX (No. = 8)	P value
Age mean $\pm$ SD, years	60.07 $\pm$ 11.53	56.63 $\pm$ 7.67	0.83
Sex male/female (No.)	30/12	6/2	0.64
Diabetes (No.)	10	3	0.34
Hypertension (No.)	16	4	0.40
Smoking (No.)	15	4	0.35
Dyslipidemia (No.)	8	1	0.55
Physically Inactive (No.)	17	4	0.45

Among the three electrocardiographic criteria compared between RCA and LCX group, ST segment elevation in III>II and ST segment depression in aVL>I was more when RCA was IRA (P = 0.01 and <0.01 respectively). Similarly presence of ST elevation in V4R correlated significantly (P = 0.04) with RCA lesion (Table 4).

**Table 4. Comparison of ECG criteria between RCA and LCX group.**

Criteria	RCA No. (%)	LCX No. (%)	P value
ST elevation III>II	39 (92.85%)	3 (37.5%)	0.01
ST depression aVL>I	40 (95.23%)	2 (25%)	<0.01
ST elevation V4R	15 (35.71%)	0 (0%)	0.04

Out of 42 participants who had RCA as IRA, 21 (50%) had lesion in proximal, 13 (31%) in mid and 8 (19%) in distal RCA. The sum of total ST segment elevation of inferior leads (II + III + aVF) for proximal RCA was 10.90  $\pm$  1.30 mm. It was 7.38  $\pm$  1.19 mm for mid and 5.50  $\pm$  0.53 mm for distal groups RCA. With statically significance (P < 0.01), the values were more in proximal followed by mid and distal groups (Table 5).

**Table 5. Total ST segment elevation in inferior leads, (II + III + aVF).**

Site	Values	P value
Proximal RCA	10.90 $\pm$ 1.30 mm	<0.01
Mid RCA	7.38 $\pm$ 1.19 mm	<0.01
Distal RCA	5.50 $\pm$ 0.53 mm	<0.01

## DISCUSSION

Acute inferior wall Myocardial Infarction (MI) is a significant cardiovascular problem. It occurs due to

lesion either in RCA or LCX. Certain abnormalities have been shown to be common in inferior wall MI. This study found sinus bradycardia in 16 (32%) patients. Complete heart block (CHB) was found in 5 (10%). Zahid Fida found sinus bradycardia in 29.6% and CHB in 7.4% of patients.<sup>7</sup> Similarly, 12.7% of CHB was found in a study by Man Hong Jim et al.<sup>8</sup>

This study found ST elevation in V4R in 30% and V7-V9 in 16% cases. A study had shown ST elevation in V4R in 54% cases and posterior MI had been reported in 15-21% of acute MI generally accompanied by inferior/lateral wall MI.<sup>9,10</sup>

Present study found 84% RCA and 16% LCX as IRA in acute ST segment elevation inferior wall MI in our set up. Result is comparable to previous studies. Al Hussain Abbase et al found 82.14% RCA as IRA.<sup>11</sup> Similarly Niels J Verouden et al found RCA as a culprit in 79%.<sup>12</sup> There was no significant difference in baseline characteristics in between the RCA and LCX group. Chun-Yen Chiang et al found similar results.<sup>13</sup> Another study showed LCX occlusion significantly higher in older age with no significant differences in other baseline characteristics.<sup>7</sup>

The criteria of ST elevation III>II and ST depression aVL>I were more likely to be present in RCA group. There are several studies published using various criteria for the predilection of IRA.<sup>14-16</sup> Herz et al found 84% sensitivity and 88% positive predictive value for the first and 82% sensitivity and 80% positive predictive value for the second criteria mentioned above. When both above criteria were combined the specificity and positive predictive value both were 100%.<sup>17</sup> Al Hussain et al also reported a significant correlation of above mentioned criteria for determination of IRA with P values <0.001 in both cases.<sup>11</sup> The study found ST elevation V4R also had a positive correlation with IRA as RCA (P = 0.04). Braat et al showed specificity and positive predictive value of 100% and sensitivity of 59% of the criterion of ST elevation V4R  $\geq$  1mm.<sup>5</sup>

The sum of ST elevation in inferior leads (II + III + aVF) in the present study was 10.90  $\pm$  1.30 mm for proximal, 7.38  $\pm$  1.19 mm for mid and 5.5  $\pm$  0.53 mm for distal RCA. This study showed a positive correlation of sum of ST segment elevation in inferior leads to the proximity of lesion in RCA (P < 0.01). Moazzam Ali Naqvi et al showed sum of ST elevation of 12.55  $\pm$  1.38 mm for proximal 8.39  $\pm$  0.89 mm for mid and 6.00  $\pm$  0.54 mm for distal RCA with significant correlation (P < 0.01).<sup>18</sup> Similarly in a study by Alim Erdem et al found the sum of ST elevation of 12.61  $\pm$  3.79 mm for proximal, 6.88  $\pm$  1.20 mm for mid and 5.05  $\pm$  0.97 mm for distal RCA.<sup>6</sup> The study of Al Hussain Abbase et al found the sum of ST segment elevation of 11.7  $\pm$  1.8 mm in proximal, 7.2  $\pm$  0.97

mm in mid and  $5.8 \pm 0.2$  mm in distal RCA lesions.<sup>11</sup> The findings of positive correlation of severity of sum of ST segment elevation in inferior leads seen in our set up was in consistent with the previously reported literatures.

The study had certain limitations. This was a single center based study done within a short time frame including small number of participants. The study only included clear cut lesions of either RCA or LCX artery. Cases with lesion in both of arteries can have different ECG manifestations. Larger studies to address the above shortcoming is encouraged and expected in future.

## CONCLUSIONS

ECG, an easily available and essential tool for the diagnosis of acute myocardial infarction could predict the infarct related artery in acute ST elevation inferior wall MI if it is RCA or LCX. The sum of ST segment elevation in inferior leads correlated with the site of lesion in right coronary artery in our set up, the more proximal lesions had greater values. These findings will help to formulate the plan for their further management.

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