**Study of pattern of ECG finding in patients undergoing coronary angiography**

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***Abstract:*** *Cardiovascular disease has emerged as a major health burden in developing countries. Cardiovascular risk factors for acute coronary syndrome (ACS) are on the rise in people of Indian origin, and ACS is now the leading cause of death. Progress in the understanding of the pathogenesis of coronary artery disease and of its treatment epitomizes scientific, evidence based medicine at its best. The aim of the research is to assess the pattern of ECG finding among CAD patient with different severity detected by coronary angiography. Patients admitted in SMS hospital with acute coronary syndrome (STEMI) were included in the study from April 2014 up to sample size completed. The study was a prospective study. The study consisted of 100 patients admitted in SMS hospital. It was found that anterior, anteroseptal and anterolateral ST elevation identified all patients with LAD as the culprit artery with 100 % accuracy. In patients with inferior ST elevation, relative ratio of ST elevation in lead II and lead III, correctly identified the culprit artery as RCA or LCx with 100 % accuracy.(ST elevation in lead II >III predicts LCx occlusion and the ST elevation in lead III > II predicts RCA occlusion.*

***Keywords****: Cardiovascular disease, ECG, coronary angiography, ST elevation, culprit artery.*

**Introduction**

It is widely acknowledged that heart cardiovascular disease (CVD) and stroke are the leading causes of death and disability in the United States and other developed countries*.*1Acute myocardial infarction is one of the common cause of death all over the world. Non communicable diseases have overtaken communicable diseases as the world’s major disease burden, with Cardiovascular disease (CVD)  remaining the leading global cause of death, accounting for 17.3 million deaths per year, a number that is expected to grow to 23.6 million by 2030. Coronary artery disease will surpass infection disease as the world’s number one cause of death and disability. 1,2

Cardiovascular disease has emerged as a major health burden in developing countries. 3 Cardiovascular risk factors for acute coronary syndrome (ACS) are on the rise in people of Indian origin, and ACS is now the leading cause of death.4 In addition to high rates of mortality, CVD manifests in low and middle income countries almost 10 year earlier than other countries*.*5,6

INTERHEART study proposed that hypertension, lipid abnormalities, smoking, obesity, diabetes, sedentary lifestyle, low fruit and vegetable intake, and psychosocial stress are important causes for MI in India.

Atherosclerosis is the result of multiple and complex gene environment interaction. Several independent risk factor have been identified including elevated serum total (and LDL) cholesterol, low serum HDL cholesterol, cigarette smoking( the single most modifiable factor), elevated blood pressure, diabetes mellitus and advancing age.7,8

ECG is generally used to diagnose myocardial infarction. However, it can also be used to predict the culprit artery and also level of occlusion in the culprit artery in patients with myocardial infarction. Various ECG criteria have been studied in the past to predict the culprit artery and also the level of occlusion in the culprit artery.9,10

If the level of occlusion is located proximally in the culprit artery, the extent of myocardial damage is likely to be large. By identifying a proximal lesion, the ECG helps to prognosticate the patients. The patients with a proximal lesion would usually have a poorer prognosis compared to those with a more distal lesion. Hence , these group of patients would require more intensive monitoring and they would benefit from a more aggressive therapy including early invasive therapy. 11

**Aims and Objectives:** To assess the pattern of ECG finding among CAD patient with different severity detected by coronary angiography.

**Materials and Methods**

Patients admitted in SMS hospital with acute coronary syndrome (STEMI) were included in the study from April 2014 up to sample size completed. The study was a prospective study. The study consisted of 100 patients admitted in SMS hospital. 100 of patient with chest pain attended SMS Hospital, wards and OPD were included in the study. Patients satisfying inclusion criteria were recruited in after taking informed consent. Selective coronary angiogram was performed with win 5 to 15 days of presentation. Data of patients underwent coronary angiogram were co-related with ECG changes. Correlation of CAG finding and ECG changes and qualitative and quantitative morphologic analysis was done. The results were interpreted accordingly.

Patients with ST elevation myocardial infarction were considered. This study was a descriptive study between ECG changes in patients with STEMI and to determine whether the ECGs correspond to the findings on a coronary angiogram and whether the ECGs can accurately predict the site of lesion and the vessel was involved. In this study 12 Lead ECG was used.

Statistical Analysis of results was done with the help of computer expert and statistical analysis done by Statistician.

**Observation and Results:**

**Table 1: Culprit artery as per coronary angiogaram**

|  |  |  |
| --- | --- | --- |
| **S. No.** | **Culprit artery** | **No. of patients** |
| 1. | LAD | 74 |
| 2. | RCA | 22 |
| 3. | LCx | 4 |
| **4.** | **Total** | **100** |

\*original

Figure 1: The culprit artery as per coronary angiogram

\*original

**Table (1)** Show the distribution of culprit arteries as per angiogram finding.

In our study 74 patients (74 %) had left anterior descending as the culprit artery, 22 patients (22 %) had right coronary artery as the culprit artery and 4 patients (4 %) had left circumflex artery as the culprit artery.

Of the 74 patients having left anterior descending as the culprit artery, 11 patients had additional lesion in the left circumflex and 9 patients in right coronary artery.

Of 22 patients having right coronary artery as the culprit artery, 3 patients had additional lesion in left anterior descending artery and 2 patient in posterior descending artery.

**Table 2: LAD the culprit artery as per ECG criteria and coronary angiogram:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S. No.** | **Level of occlusion in culprit artery as per ECG criteria** | **Percentage of patients** | **Level of occlusion in culprit artery as per CART** | **Percentage of patients** |
| 1. | LAD proximal to D1 | 24% | LAD proximal to D1 | 73% |
| 2. | LAD distal to D1 | 41% | LAD distal to D1 | 27% |
| 3. | Intermediate group either proximal or distal to D1 | 35% |  |  |
|  | **Total** | **100** |  | **100** |

\*original

Figure 2: LAD as the culprit artery as per ECG criteria and angiogram:

\*original

**Table (2)** shows percentage of distribution of lesion in relation to D1 (proximal or distal) as per ECG finding 24% patients had occlusion of LAD proximal to D1, 41% had distal to D1 and 35% were in intermediate group. As per angiogram 73% patients had occlusion of LAD proximal to D1and 27% patients had distal to D1.

**Table 3: Culprit artery in inferior MI as per ECG changes and angiogram**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Clinical Diagnosis** | **No. of Patients** | **Surface ECG ST Elevation** | **ECG Criteria** | **No. of Patients full filling ECG Criterion** | **Culprit artery as per our ECG criterion** | **Culprit artery as per coronary angiogram** | | |
|
| 1. | Inferior wall MI | 22 | ST elevation in II, III, and aVF | ST elevation III > II | 18 | RCA | RCA Proximal to RV | | RCA distal to RV |
| 13 | | 5 |
| ST elevation in II > III | 4 | LCx | 4 | | |
| 2. | Inferior wall MI with Right ventricular MI | 4 | ST elevation in II, III, aVF and V1 & V4R | ST elevation in V1 and V4R | 4 | RCA Proximal To RV | RCA Proximal TO RV | RCA Distal to RV | |
| 3 | 1 | |
| **3.** | **Total** | **26** |  | **26** | |  | **20** | **6** | |

**Table (3)** shows 22 patients of inferior wall MI of the 18 had RCA as culprit artery, 4 as LCx culprit artery and 4 inferior wall with RVMI 3 of 4 had RCA proximal to RV & 1 had RCA distal RV branch as culprit artery.

**Figure 3: RCA as the culprit artery:**

\*original

**Figure (3)** shows percentage of distribution of lesion in relation to RV branch of right coronary artery. 73% of the patients had lesion proximal to RV branch of right coronary artery and 27% had lesion distal to RV branch.

**Predicting level of occlusion in RCA:**

ST elevation in lead V4R suggests RCA occlusion proximal to RV branch, whereas isoelectric or depressed ST segment in V4R suggests RCA occlusion distal to RV branch. (Criterion described by *Bairey CN, Shah & Herz I et al)*).12

Number of patients having RCA occlusion – 22

Lead V4R available – 5 patients

ST segment elevation in V4R – 4 patient

**Table 4**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **ECG Changes** | **ECG Criterion** | **No. Patients full filing ECG Criterion** | **As per Angiography** | | |
| 1. | ST elevation in  II,III & aVF | ST elevation  III>II RCA | 18 | RCA Proximal  to RV | | RCA  distal RV |
| 13 | | 5 |
| 2. | ST elevation in  II,III & aVF | ST elevation  II>III LCx | 4 | 4 | | |
| 3. | ST elevation  in II,III, aVF &  V4R | RCA proximal to  RV branch | 4 | Proximal to RV | Distal to RV | |
| 3 | 1 | |

\*original

In our study 22 patients had RCA as culprit artery in which 16 patients had RCA proximal to RV branch and 6 patients had occlusion RCA distal to RV branch, and 4 patients had LCx as culprit artery. In above out of the 4 patients having ST elevation in V4R, only 3 patients (75%) had occlusion proximal to RV branch of RCA as predicted by ECG (prediction correct in 3 of 4, PPV – 75%) One patient had ST depression in V4R, and he actually had occlusion distal to RV branch as predicted by the ECG.

**Discussion:**

This prospective study of adult patients included 100 patients. The mean age of the patients was 52.95. Out of these 87% were men and 13% were women.

1. **Distribution of culprit artery:**

Left anterior descending artery – 74

**According to ECG criteria:**

Occlusion proximal to D1 - 18

Occlusion distal to D1 - 30

Intermediate group lesion either proximal or distal to D1 - 26

**As per angiogram level of occlusion:**

Occlusion proximal to D1 - 54

Occlusion distal to D1 - 20

**2. Culprit artery prediction :**

Anterior, anteroseptal and anterolateral ST elevation identified all patients with LAD as the culprit artery with 100 % accuracy in our study population.

In patients with inferior ST elevation, relative ratio of ST elevation in lead II and lead III, correctly identified the culprit artery as RCA or LCx with 100 % accuracy.(ST elevation in lead II >III predicts LCx occlusion and the ST elevation in lead III > II predicts RCA occlusion.

**3. Predicting the level of occlusion within the culprit artery.**

**(a) Validity of Fiol et al’s criteria to predict the level of occlusion in LAD in our study population :**

Thus marked ST depression in III, aVF (Sum of ST depression in III and AVF ≥ 2.5 mm) was found to have high specificity(85 %) for a occlusion proximal to D1 but with a low sensitivity of 28 % with PPV 83 & NPV 30.

On the other hand an elevated or isoelectric ST segment in III, aVF has moderate sensitivity and moderate specificity (65% and 69% respectively) for an occlusion distal to D1 with PPV 43 & NPV 84. (Described by ***Fiol et al)***

**(b) Validity of Engelen et al’s**13 **criteria to predict the level of occlusion in LAD in our study population:**

We found that ST depression in III ≥ 2.5 and ST depression in aVF ≥ 2 were both found to have very high specificity (100% each) for lesion proximal to D1 , but very low sensitivity (13% and 15% respectively).

Also ST depression in II ≥ 1 and ST depression in aVF ≥1 were found to have high specificity (95% and 80% respectively) for lesion proximal to D1, but very low sensitivity (28 % and 44 % respectively).

**Conclusions:**

ECG criteria have excellent sensitivity and specificity in predicting the culprit artery. ECG criteria described by Engelen et al13 have low to medium sensitivity but fairly high specificity for predicting the level of occlusion in patient with LAD culprit lesion.

Our results (sensitivity, specificity, PPV, NPV) are broadly similar to the results obtained by the original study by (Engelen et al)13 in a Western population. ECG criteria described by Fiol et al and those described by Engelen et al13 retain validity in a our study population as well, as established by this study.

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