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THE IMPACT OF ECG ON THE LOCATIZATION OF CULPRIT VESSEL OCCLUSION IN ACUTE STEMI WITH 2D ECHO AND ANGIOGRAPHIC CORRELATION

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ABSTRACT

Background & Objectives: In order to diagnose and treat acute myocardial infarction, the electrocardiogram continues to be a vital tool. A thorough examination of ST-segment elevation patterns may have an impact on the perfusion therapy's decision-making process. This study was done to connect coronary angiography and 2D ECHO results with ECG results in individuals with acute ST elevation myocardial infarction to determine the culprit vessel.

Materials & Methods: The participants in this prospective study were 50 patients at the SNMC and HSK Hospital in Bagalkot. Patients with ST segment elevation on the ECG were assessed to determine the responsible vascular and afterwards correlated with a 2D ECHO coronary angiography.

Results: In this study, 50 patients, 36 of whom had anterior wall and 14 of whom had inferior wall myocardial infarction. The most specific criteria in proximal RCA occlusion were ST elevation > 1mm in V4R, and ST depression V3 / ST elevation LIII Lead II was also the most sensitive . While in the patients with distal RCA occlusion, ratio of ST depression V3/ST elevation LIII >1.2 was sensitive. The maximum sensitivity for localising occlusion in proximal D1occlusion was also found in inferior leads ST depression > 1mm. The most sensitive criterion for blockage distal to S1 and in distal D1 in AWMI is the absence of ST depression in inferior leads.

Conclusion: In patients with ST elevation AMI, the admission ECG is useful not only for deciding on early reperfusion therapy but also for providing crucial information to direct therapeutic decision-making.

Key words: ECG, AMI, ST segment elevation

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INTRODUCTION:

The primary causes of death and disability worldwide, in both industrialised and developing nations, are universally recognised to be heart disease and stroke.[1] A true global cardiovascular disease (CVD) epidemic is currently in progress.[2,3] Every year, around 30% of fatalities globally are caused by CVD. Nearly 80% of these fatalities take place in underdeveloped nations. Indeed, the leading cause of death in practically every part of the world is cardiovascular disease.[4] AMI has a 30% early (30-day) mortality rate, with more than half of these deaths taking place before the patient even gets to the hospital. Despite a 30% reduction in the mortality rate following AMI admission over the past two decades, 1 in 25 patients who survive the initial hospital stay pass away within the first year of their AMI. Elderly patients (those over 75) have a mortality rate that is almost four times higher than that of younger ones.[5]

In order to diagnose and treat acute myocardial infarction, the ECG continues to be a vital tool. Myocardial infarction acute risk stratification continues to be focused on straightforward clinical indicators such as laboratory markers and 12-lead electrocardiography. One of the most helpful diagnostic examinations for myocardial infarction has been the ECG. Based on the patterns and severity of ST deviation, patients are classified as having an anterior, inferior, or lateral myocardial infarction.

Decisions relating to the perfusion therapy may be influenced by a thorough investigation of ST-segment elevation patterns.[5] It is possible to forecast the region of the myocardium that is at risk and make decisions about the urgency of revascularization with the early and precise identification of the infarct-related artery.[1] Electrocardiographic reperfusion signals are a crucial indicator of micro-vascular blood flow and, thus, of prognosis. While coronary angiography identifies the vascular anatomy, electrocardiography depicts the electrophysiology of the myocardium during acute ischemia.

In order to plan an early, quick intervention and revascularization, this study aims to validate the value of electrocardiography in identifying the responsible vessel in acute ST elevation myocardial infarction and connecting the findings with coronary angiography and echocardiography.

METHODOLOGY

After receiving approval from the institutional ethical committee, a case-series was conducted in department of General Medicine, SNMC and HSK Hospital, Bagalkot, Karnataka.

The study was conducted for a period of 18 Months from May 2021 to November 2022. Fifty cases of acute myocardial infarction attending the General medicine department of SNMC and HSK Hospital, Bagalkot, with acute myocardial infarction and chest pain lasting more than 30 minutes, without regard to gender, patients who had coronary angiography and echocardiography and had a ST segment elevation of at least 1 mm in at least two adjacent leads in the limb leads and 2 mm in the chest leads of the ECG were included in the study.

We excluded patients with history of previous myocardial infarction, prior CABG, congenital heart disease and left BBB in baseline ECG.

All eligible individuals were assessed using a conventional 12-lead ECG and cardiac enzymes (Troponins and/or CK and CK-MB) after providing written informed consent. A

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thorough history of the chest discomfort, risk factors present, and their duration were obtained as necessary. followed by general and systemic examination.

The inferior wall and anterior wall infarctions of acute myocardial infarction were distinguished. The culprit vascular was found using the various ECG criteria. Reports from echocardiography and coronary angiography were gathered. The infarct associated artery (IRA) was found to be completely blocked or to have considerable (> 70%) stenosis.

All collected data were written down and displayed as mean standard deviation. The ECG results from patients with anterior and inferior walls were compared using SPSS 16 software, when necessary. Statistical significance was defined as a P-value 0.05. Individual parameter sensitivity and specificity were estimated.

RESULTS

A total of 50 eligible cases were admitted during the study period. Table 1 shows the baseline characteristics of study population. Majority were males (78%) aged between 40 to 60 years (50%), were smokers (64%) and had hypertension (32%).

Table 1: Baseline characteristics of study participants

Baseline characteristics		**Frequency**	**Percentage**
Age	**<40 years**	3	6%
	40 to 60 years	25	50%
	>60 years	22	44%
Gender	**Males**	39	78%
	Females	11	22%
Habits	**Smoking**	32	64%
	Alcoholism	30	60%
Co-morbidities	**Diabetes Mellitus**	14	28%
	Hypertension	16	32%
	CKD	1	2%
	Hypothyroidism	1	2%
	HbSAg positive	1	2%
	RVD positive	1	2%

Out of 50 patients included in this study, 14 patients had IWMI and 36 patients had AWMI**.** Echocardiography showed RWMA in 39 patients, and had no RWMA in 11 patients. Echo showed only RCA territory RWMA in 9 patients, only LAD territory RWMA in 26 patients, RCA and LAD territory in 1 patient, and LCX and LAD territory in 3 patients (Table 2)

Table 2: ECG, ECHO and CAG characteristics

Characteristics		**Frequency**	**Percentage**
ECG	**IWMI**	14	28%
	AWMI	36	72%
ECHO: RWMA	**Present**	39	78%

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	Absent		11	22%
ECHO: Territory	**RCA**		9	18%
	LAD		26	52%
	RCA+LAD		1	2%
	LCX+LAD		3	6%
CAG	**Normal**		5	10%
	Occlusion	**RCA**	23	46%
		LAD	38	76%
		LCX	18	36%
		LMCA	2	4%

Among 14 patients with IWMI, 11 patients had RCA stenosis in CAG. Sensitivity of ECG in localizing RCA stenosis was 47.8 %, and specificity was 88.8 % in the current study. Among 36 patients with AWMI, 31 patients had LAD stenosis in CAG. Sensitivity of ECG in localizing LAD stenosis was 81.5%, and specificity was 58.3 % in the current study. Out of 38 patients having LAD territory occlusion in CAG,12 patients had block in proximal LAD,9 had block in distal LAD, 6 had block in proximal to S1 - distal to D1, and 11 had block in proximal to D1 - distal to S1 (Table 3).

ECHO in localizing RCA territory occlusion had sensitivity of 39.1% and specificity of 96.2% in the current study. ECHO in localizing LAD territory occlusion had sensitivity of 68.4% and specificity of 66.6% in the current study (Table 3).

Table 3: Comparison of ECG and ECHO with CAG

CAG		**Sensitivity**	**Specificity**
ECHO	**RCA territory**	39.1%	96.2%
	LAD territory	68.4%	66.6%
ECG	**RCA stenosis**	47.8%	88.8%
	LAD stenosis	81.5%	58.3%
ECG+ECHO	**RCA STEMI**	41.1%	96%

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	LAD STEMI	78.8%	53.8%

DISCUSSION

The current study's objective was to determine the involved coronary artery occlusion in acute STEMI and evaluate how it compared to the ECG results. The study involved 50 patients with acute ST-elevation myocardial infarction who were randomly chosen and received cardiac enzymes, 2D ECHO, a coronary angiography, and an ECG as part of their diagnostic

Among the 50 study cases 39 (78%) were male and 11(22%) were female. In our study the mean age of presentation in men was 58.38 years and 62.36 years in women. The youngest age of presentation was 25 years and maximum age of presentation was 83 years. In this study, the incidence of CAD was around four times higher in men than in women. According to a study conducted in Washington State, coronary artery disease (CAD) kills both men and women equally throughout the course of their lifetimes. In 1991, there were 42% more female CAD deaths in Washington State than male CAD deaths (39%).6 The Copenhagen City Heart Study indicated that the incidence of CAD in men was roughly double that of women in a 21-year follow-up of 12,000 men and women.[7] In the 26-year follow-up of men and women aged 35 to 84 in the Framingham Heart Study found that 60% of coronary events occurred in men, and CAD morbidity was twice as high in men.[8] Similar to this, the incidence of CAD in males (119) was more than twice that of females (27) in Hadjadj, Coisne, Mauco, et al..[9]

In our study, patients with ACS most frequently fell into the 40–60 age range (50%) and those over 60 years (44%) age groups. Patients with ACS were 59.26 years old on average. The INTERHEART Study found that North America (59), Southeast Asia (57), and Japan (59) had nearly identical mean ages (years) to those found in our study.[10]In The CREATE-ECLA Randomised Controlled Trial, which was essentially identical to this trial, patients' mean ages were 58.6 years.11The strongest independent risk factor for atherosclerosis is ageing.

Smoking was identified as the most common risk factor, accounting for 32 out of 50 (64%) acute myocardial infarction patients in our study and alcohol 30 out of 50(60%), all of them where males. Women keeping their cultural practices where neither smokers nor

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alcoholics. An key modifiable risk factor is smoking. In India, smoking is becoming more common. According to this study, smoking (64%) was one of the major risk factors for CAD. Coronary artery disease has been linked to smoking on its own as a risk factor. 60% of patients with coronary artery disorders in the Framingham Study were smokers. Smoking increases the risk of coronary artery disease by interacting with other risk factors in a synergistic manner.[12]

Hypertension was seen in 16 out of 50 (32%) in our study. Ten (25.6%) men and 6(54.5%) women were found to be hypertensive in our study. According to a study Taba kazemi et al.[13] it showed 50% of women and 24.4% of men were hypertensive in patients with acute MI. Diabetes was seen in 14 out of 50 (28%) in our study . Twelve (30.7%) men and 2(18.1%) women were found to be diabetic in our study.

For the purpose of identifying the culprit artery and afterwards correlating it with echo and coronary angiography, several ECG criteria were examined in both groups. The 50 individuals who were enrolled in the study had an average of 36 anterior wall and 14 inferior wall myocardial infarctions. To find the responsible artery in patients with anterior wall myocardial infarction, many criteria were examined. Our investigation demonstrates that ST depression in L3 and aVR had the highest sensitivity in localising occlusion proximal to D1, distal to S1, in the culprit vessel. The most specific ST dip in the aVL and V5 occurs in the vicinity of S1 and distal to D1.

The culprit lesion was in the RCA in 11 of the 14 individuals who had acute inferior MI. A ratio of elevation in lead III/elevation in lead II > 1 was found to have a specificity of 88.8%, sensitivity of 47.8%, PPV of 78.5%, and NPV of 66.6% for RCA occlusion in the current investigation when ST segment elevation in lead III exceeded that in lead II. These findings are in line with study by Radhakrishnan Nair and D. Luke Glancy, who found that RCA involvement had a sensitivity of 96%, a specificity of 40%, an 89% positive predictive value, and a 67% negative predictive value.[14] These results are in line with earlier research from Zimetbaum et al.[15], who demonstrated that RCA occlusion was the sole circumstance in which lead III's ST segment elevation was higher than lead II's. These findings imply that a key predictor of RCA blockage is a ratio of ST elevation in lead III/ST elevation in lead II > I.

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According to Bailey et al.[16], RCA blockage was the sole condition that caused ST segment depression in lead I and aVL. According to Birnbaum et al.[17], lead aVL ST segment depression is a sensitive early ECG indicator of RCA blockage. Similar to Huey et al.[18], Kontos et al.[19] found ST depression in lead I in 28% of their LCX patients and in 58% of their RCA patients, as opposed to Huey et al.[18], who found ST depression in lead I in 22% of their LCX patients and in 59% of their RCA patients.

Any medical personnel working in emergency care should be well-versed in ECG evaluation in ST elevation MI. Emergency primary care physicians should be aware of the following ECG findings:

1. Anterior myocardial infarction with proximal LAD coronary artery obstruction.
2. Patients with inferior acute myocardial infarction, multivessel disease, or grade III ischemia or ST depression in V4-V6.
3. Acute inferior myocardial infarction in conjunction with right ventricular infarction.

In cases of acute anterior myocardial infarction, it's critical for emergency medical professionals to recognise a very close LAD coronary artery occlusion. A significant section of the left ventricle, including the anteroseptal, anterosuperior, anterolateral, and apical areas, is at risk for infarction if the infarct site is close to the first diagonal branch of the LAD artery. These high-risk patients may need to be treated right away in the emergency room with a thrombolytic drug or they may need to be sent urgently to the cardiac catheterization laboratory for primary percutaneous coronary intervention.

A second ECG with right ventricular leads should be taken in individuals with acute inferior myocardial infarction since it is common to find isoelectric ST segments in these leads. Right ventricular infarction can be diagnosed and no additional right precordial ECGs need to be taken if lead V4R shows ST segment elevation of 1 mm. Identification of patients with right ventricular infarction is crucial because hypotension in these patients is typically brought on by both the right ventricle's weak contraction and the left ventricle's insufficient filling. Therefore, the goal of treatment should be to increase ventricular filling through volume expansion while avoiding nitrates and diuretics. Such treatment is incompatible with that used to treat cardiogenic shock brought on by pump failure, as is the case in severe left ventricular infarctions.

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ECG and ECHO versus CAG in localising RCA territory STEMI had sensitivity of 41.1% and specificity of 96%. ECG and ECHO versus CAG in localising LAD territory STEMI had sensitivity of 78.78% and specificity of 53%. In the study by Pandey RP et.al.[20] Sensitivity, Specificity, PPV, and NPV of ECG as compared to echocardiography were found to be 96.6%, 85.3%, 90.5%, and 94.6% in the LAD territory; 93.3%, 92.8%, 84.8%, and 97% in the RCA territory; and 50%, 98.9%, 75.5%, and 96.8% in the LCx territory, respectively.

Limitations: In our study, female patients formed only 22 % as the study group was randomly selected. Sample size of only 50, hence a study with larger sample should be considered. All the patients were not evaluated for risk factors, only a few patients were evaluated for risk factors .Detailed study with more sample size should be considered as MI is one among leading cause for mortality and morbidity.

CONCLUSION

In patients with ST elevation acute myocardial infarction, the admission ECG is important for identifying who needs early reperfusion therapy and who does not, as well as for revealing the location and severity of acute myocardial injury. The ECG can provide crucial information to direct care and establish prognosis by reflecting the pathophysiology of the myocardium during acute ischemia. The majority of early and full revascularization techniques, including angioplasty, are most effective in treating moderately big myocardial infarctions identified by electrocardiographic indications of proximal coronary artery blockage. Although these criteria don't completely replace invasive procedures for identifying the culprit artery in acute myocardial infarction, they do offer a quick, reliable, and affordable way to identify infarct-related arteries.

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