Original Article

Frequency of Left Main Coronary Artery Disease in Patients Having ST-Elevation in Lead AVR on Electrocardiogram Presenting with Acute Coronary Syndrome

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ABSTRACT

Objective: To determine the frequency of left main coronary artery disease in patients presenting with acute coronary syndrome having ST elevation in lead avR**.**

Study Design: Descriptive/ cross sectional study

Place and Duration of Study: This study was conducted at the Department of Cardiology, Liaquat National hospital, Karachi from March 2019 to September 2019.

Materials and Methods: Total 246 patients presented with acute coronary syndrome had ST elevation in lead avR > 0.5 mm on ECG were included. Demographic data were recorded. All patients underwent coronary angiography to diagnose coronary artery disease. SPSS version-21 was used. Descriptive statistics were calculated. Stratification was done and chi square test was applied. P-value ≤0.05 was taken as significance.

Results: There were 174 male and 72 female patients. The mean duration of chest pain was 45.01±14.40 minutes. 42.3% were diabetic, 58.9% were hypertensive, 37.8% were smokers, and 42.3% were obese. The left main stem disease was observed in 201(81.7%) patients and its significant association was observed with smoking and obesity with p<0.05.

Conclusion: The ST-segment elevation on lead aVR was an important predictor of occurrence of left main disease in patients with ACS.

Key Words: Left Main Coronary Artery Disease, Electrocardiography, ST Elevation In Lead avR, Angiocardiography

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INTRODUCTION

Coronary artery illness is among the top causes of mortality in the globe[1,2]. Acute coronary syndrome comprises of ST-elevation myocardial infarction, unstable angina and non-ST elevation myocardial infarction. Identification of clinical and electrocardiographic characteristics predictive of severe left main coronary artery disease is critical, especially in individuals diagnosed with an acute coronary syndrome[3].

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A severe left main stem stenosis is known to be a lesion comprising over 50 percent of the vessel diameter. Left main stem stenosis usually occurs in 3 percent to 5 percent of all individuals undergoing coronary angiography[4-6] and in 30 percent of coronary artery bypass grafting patients [4,7].

This is associated with multi-vessel coronary artery disease about 70 per cent of the time[8,9] as present. Majority of individuals are symptomatic and at significant risk of coronary problems, since this vessel's occlusion reduces the flow of at least 75% of the left ventricle, whether it is covered by collateral flow or patent bypass grafting to either the left anterior descending artery or left circumflex arteries. Studies carried out before revascularization with coronary artery bypass graft became the standard of treatment showed a weak prognosis for these patients, with survival of three years as low as 37 per cent [10]. Coronary artery bypass graft is associated with slightly improved coronary outcomes including survival as compared directly to conventional treatment[11].

For one study, the finding on electrocardiogram of the ST-segment elevation for lead avR bis V1 separated the left main stenosis group from the left anterior

descending artery group with elevated diagnostic values of 80 percent of the left main coronary artery disease[12].
The aim of my study is to determine the frequency of left main coronary artery disease in patient with acute coronary syndrome with ST elevation in lead avR. If result of my study shows high frequency of left main coronary artery disease, then recommendation will be to manage the patient earlier so that we can reduce morbidity and mortality.

MATERIALS AND METHODS

Two hundred and forty six consecutive patients from Department of cardiology, Liaquat National hospital, Karachi from March 2019 to September 2019 were enrolled in study after fulfilling the inclusion criteria. Risks, benefits and procedure of research were explained to the patient and informed consent was taken by the investigator. Demographic data like name, age, gender, chest pain, co-morbids and left main disease were recorded on the attached performa. Identity was kept confidential. No fatal risk was present in the study. All patients had ST-segment elevation in lead avR were underwent coronary angiography (which is the gold standard to diagnose coronary artery disease) to diagnose left main coronary artery disease.

Sample Selection

Inclusion Criteria:

Both genders. Age above 40 and below 75.

Patients presenting with acute coronary syndrome having ST-elevation in lead avR > 0.5 mm on electrocardiogram.

Exclusion Criteria: Patients with chronic kidney disease who were on dialysis (GFR<15ml/min/1.73m2).

Patients having severe anaemia (Hb< 7g/dl).

Patients with dextro-cardia defined by heart on the right side on chest x-ray.

Patients who underwent circulatory collapse requiring cardiopulmonary resuscitation or any major complication during angioplasty like cardiogenic shock, renal failure or unconsciousness. (confirmed by patient history)

Patients having ejection fraction less than 20%.

Patients having previous history of coronary artery bypass graft.

Data Analysis: Confounding variable and biasness were controlled strictly by following inclusion and exclusion criteria. Data were analyzed using SPSS Version 21 quantitative data like age, duration of chest pain were presented as mean and standard deviation. Qualitative data like gender, diabetes mellitus, hypertension, smoking, obesity and left main coronary artery disease were presented on frequency tables and percentages. Data were stratified for age, duration of chest pain, gender, diabetes mellitus, hypertension, smoking and obesity. Post stratification Chi-Square test was used. P value < 0.05 was taken as significant.

RESULTS

In this analysis, a total of 246 patients of either sex over 40 years of age and below 75 years of age with acute coronary syndrome with ST-elevation on electrocardiogram in lead avR > 0.5 mm were included to evaluate the left main stem condition. After stratification Chi square test was applied to observe the effect of modifiers on the result. It was found that P-value 0.05 was relevant.

The findings showed 174 patients were male and 72 were female. The distribution of frequencies is set out.

The median age of subjects at study was 54.42±9.35 years. The detailed descriptive age statistics are presented. For two classes age has been stratified. The lifespan of 155 patients was around 55 years and > 55 years was the lifespan of 91 patients. It provides detailed systematic estimates of age by age group.

The mean duration of chest pain was 45.01±14.40 minutes. The duration of chest pain was stratified in two groups. Duration of 130 patients was ≤45 minutes and duration of 116 patients was >45 years. The detailed descriptive statistics of duration of chest pain according to groups are presented.

The findings were reported individually on the history of associated diseases. Tests revealed that 42.3 per cent of patients had diabetes. Patients were 58.9 per cent hypertensive, 37.8 per cent smokers, and 42.3 per cent obese. The results showed that among total patients, STEMI was observed in 56.5% patients, NSTEMI was observed in 26.8% patients, and unstable angina was observed in 16.7% patients. Final outcome i.e. left main stem disease was observed in 201(81.7%) patients.

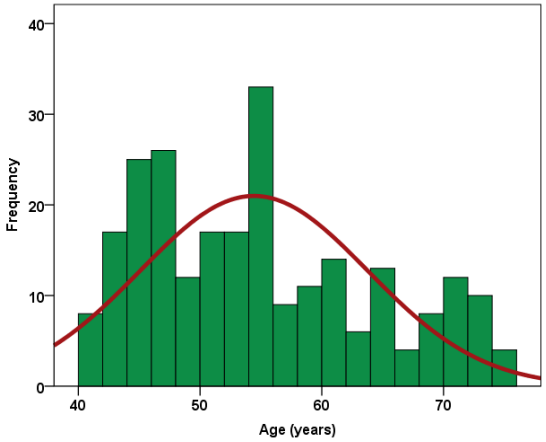
Stratification with regard to sex, age, period of chest pain, diabetes mellitus, hypertension, smoking, and obesity was performed to determine the impact on outcome of these modifiers. Chi square post stratification check was used and p-value 0.05 was found to be relevant. The results showed that smoking (p=0.017) and obesity (p=0.003) were significantly associated with left main stem disease. No significant association of left main stem disease was found with gender (p=0.764), age (p=0.825), duration of chest pain (p=0.163), diabetes (p=0.321), and hypertension (p=0.873). Detail description is given in tables no. 1, 2 and 3 and in graphs 1 and 2.

Table No.1: Descriptive statistics of age, duration of chest pain

Statistics	Age (Years)	Duration of chest pain (minutes)
Minimum	41	25
Maximum	72	70
Mean	54.42	45.01
Std. Deviation	9.35	14.40

Table No. 2: Frequency distribution of gender, Diabetes mellitus, hypertension, smoking status, Provisional diagnosis(n=246)

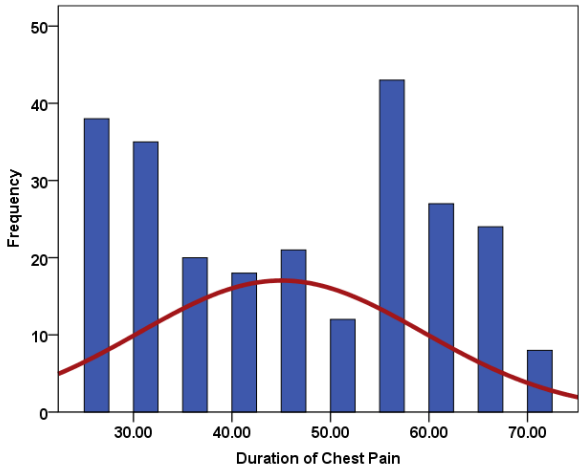
Gender	Frequency (n)	Percentage (%)
Male	174	70.7%
Female	72	29.3%
Total	246	100%
Diabetes mellitus	Frequency (n)	Percentage (%)
Yes	104	42.3%
No	142	57.7%
Total	246	100%
Hypertension	Frequency (n)	Percentage (%)
YES	145	58.9%
NO	101	41.1%
Total	246	100%
Smoking status	Frequency (n)	Percentage(%)
YES	93	37.8%
NO	153	62.2%
Total	246	100%
Obesity	Frequency (n)	Percentage (%)
YES	104	42.3%
NO	142	57.7%
Total	246	100%
Provisional diagnosis	Frequency (n)	Percentage (%)
STEMI	139	56.5%
NSTEMI	66	26.8%
UA	41	16.7%
TOTAL	246	100%
Left main disease	Frequency (n)	Percentage (%)
YES	201	81.7%
NO	45	18.3%
TOTAL	246	100%



Graph No.1: Histogram presenting distribution of age (years) (n=246)

Table No. 3: Frequency and association of left main stem disease according to gender(n=246)

	Left Main Stem Disease		Total	P-value
	Yes (n=201)	**No** (n=45)	**Total**	**P-value**
Male (n=174)	143	31	**174**	0.764**
Female (n=72)	58	14	**72**	
TOTAL	**201**	**45**	**246**	
	Left Main Stem Disease		**Total**	**P-value**
	Yes (n=201)	**No** (n=45)		
≤ 55 years (n=155)	126	29	**155**	0.825**
> 55 years (n=91)	75	16	**91**	
TOTAL	**201**	**45**	**246**	
	Left Main Stem Disease		**Total**	**P-value**
	Yes (n=201)	**No** (n=45)		
Yes (n=93)	69	24	**93**	0.017*
No (n=153)	132	21	**153**	
TOTAL	**201**	**45**	**246**	
	Left Main Stem Disease		**Total**	**P-value**
	Yes (n=201)	**No** (n=45)		
Yes (n=104)	94	10	**104**	0.003*
No (n=142)	107	35	**142**	
TOTAL	**201**	**45**	**246**	



Graph No. 2: Histogram presenting distribution of duration of chest pain (minutes) (n=246)

DISCUSSION

The most daunting lesion in people with acute coronary syndromes is left main coronary artery stenosis. Although the amount of myocardium at risk is very high, the patient is always in a cardiogenic shock, with a high risk of death and much more so in a left dominant coronary system.[1]

Total left main thrombosis typically leads to abrupt cardiac arrest and patients who are affected will end up dying before they arrive at hospital. In example , patients with subtotal left main occlusion may have an acute coronary syndrome with a generalized electrocardiographic pattern of ST depression in the anterior with inferior leads.13 In the case of acute coronary syndromes, STE-aVR (1 mm) with diffuse ST weakness in other leads is generally a symptom of extreme left main disease; it is often associated with poor results...[14,15]Ionescu et al16 stated that the electrocardiographic findings of thrombosis of the left principal coronary artery could be unspecific. STE-aVR will, however, raise fears of serious left principal disease. Furthermore, Taglieri et al17 reported that STE-aVR and reciprocal ST depression in other leads are highly predictive of serious left main disease in the context of non-STE acute coronary syndrome.

The mechanism of STE-aVR is not completely understood.18 Lead aVR is electrically opposed to leads D1, D2, aVL, and V3–V6, and therefore a ST depression in these leads induces reciprocal STEaVR;19 however, lead aVR directly represents the electrical activity of the right upper part of the heart, including the basal portion of the interventricular septum and, subsequently, a transmural infarction. Accordingly, STE-aVR is thought to arise from one of the following two mechanisms: diffuse antero-lateral subendocardial ischemia with reciprocal improvement in aVR or basal portion of the heart transmural infarction.[19] However, an anatomical version of the Purkinje fibers was evoked[18] to clarify the absence of STE in anterior leads in some cases, following anterior transmural infarction.

The upper right portion of the heart is the outflow path of the right ventricle and the basal portion of the interventricular septum, is supplied by the main stem of the left coronary artery and/or branches of the proximal sections of the left anterior descending artery; thus, lesions in these coronary segments induce elevations of the ST-segment in lead aVR due to the dominance of the basal ventricular mass, this should lead to produce elevation in lead aVR, as the ST-segment vector in the frontal plane points in a superior direction.[20,21]

In most studies Lead aVR showed ST- segment elevation in occlusion of left main stem.[22] In one study there was 88% (14/16) of patients showed ST segment-elevation in Lead aVR in the occlusion of left main stem group, whereas ST- segment elevation was found in 43% (20/46) of patients in the left anterior descending artery group and only 8% (2/24) of patients in the right coronary artery group.[23]

Kosuge et al conducted a comparable study to find, in patients with acute coronary syndrome, an early, clear and non-invasive indicator of left main stem or 3-vessel disease. He conducted a retrospective ECG study of 310 patients diagnosed with acute myocardial infarction in the ST-segment elevation, which was subsequently coronary angiography. Multivariate ECG findings review determined ST-segment elevation greater than 0.5 mm in lead aVR as the best indicator of left main stem or 3-vessel disease, higher than ST-segment depression in other leads.[11]

The AVR on a 12-lead ECG gives useful information of heart upper right side of heart. This is typically not used in clinical settings, however, and is usually used and interpreted as reciprocal information from the left lateral leads, or to detect changes in endocardial electrography. During the 1980s, it was noted that ST elevation in lead aVR was correlated with LM occlusion.23 But up until the late 1990s, ECG interpreters still ignored the aVR.[26]

Reports have shown over the past couple of years that ST elevation in lead aVR was not only associated with an occlusion of LM but also demonstrated an anterior wall infarction. As was mentioned earlier, and as proven in our data, ST elevation in lead aVR strongly suggests a significant LM lesion. Furthermore, if followed by ST elevation in lead V1, the specificity of an LM lesion which acts as the vessel of the guilty increases. Given that both leads aVR and V1 have ST elevations, a greater magnitude of ST in lead aVR relative to lead V1 is very similar to LM occlusion.[23-24]

In 2016, Morris et al studied a total of 12 best evidence papers chosen from 141 publications and found that "In patients with acute coronary syndrome, STE in lead aVR can reliably identify acute myocardial infarction caused by lesion with LMCA" and found that it has only a limited diagnostic benefit to identify patients with LMCA stenosis.25 Lead aVR reports a mirror-like image of lead V5.Therefore, if the lateral precordial leads contain depression in the ST-segment, lead aVR will almost exclusively display elevation in the ST-segment. Additionally, lead aVR has a special location by "looking" from the right shoulder into the left ventricular cavity, thereby indicating ischemia of the left ventricular wall's internal layers.[3,24]

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Upon multivariate evaluation, elevation of the ST segment in lead aVR was the only variable from the initial ECG that was closely correlated with repeated ischemic events and heart failure in hospitals, and was maintained as an independent predictor of death. Accordingly, Barrages concluded that the worse results in these cases would motivate doctors to try an early invasive method in treating patients with such alarming electrocardiographic findings.[19,28]

In our study left main stem disease was found in 201(81.1%) patients who had ST segment elevation on aVR lead. The significant association was observed with smoking and obesity. No association was observed with sex, age, duration of chest pain, diabetes, hypertension, and smoking. These results are comparable with the above stated studies and literature.

CONCLUSION

STE-aVR in the context of acute coronary syndrome is often associated with left main coronary severe disease and clinicians need to be alerted of this critical condition. For patients with acute coronary syndrome the elevation of the ST section for lead aVR distinguishes patients with serious coronary artery disease on angiography. In the global evaluation of patients with acute coronary syndrome, the study of electrocardiographic anomalies in lead aVR of widely available standard ECGs is critical.

In conclusion, the result of this study found that ST-segment elevation on lead aVR was an important predictor of occurrence of left main stem disease and found that ST-segment elevation in lead aVR was associated with increase risk factors like smoking and obesity.

Author's Contribution:

Concept & Design of Study:	Naveen Roy
Drafting:	Faisal Ahmed, Muhammad Ali Shakir
Data Analysis:	Sarfraz Ali Mangi, Imran Khan Sandeelo, Nouman Kakepoto
Revisiting Critically:	Naveen Roy, Faisal Ahmed
Final Approval of version:	Naveen Roy

Conflict of Interest: The study has no conflict of interest to declare by any author.

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