

EARLY, NON-INVASIVE PREDICTORS OF LEFT MAIN OR 3-VESSEL DISEASE IN PATIENTS WITH NON-ST-SEGMENT ELEVATION ACUTE CORONARY SYNDROME

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ABSTRACT

Background: Acute coronary syndrome remains the leading cause of morbidity and mortality worldwide .It describes aspectrum of clinical syndromes ranging from unstable angina(UA) and non-ST-elevation myocardial infarction(NSTEMI) to ST-segment elevation myocardial infarction (STEMI).

Methods: This study had been done in cardiology department, faculty of Medicine, Zagazig university during the period from July 2009 to April 2011. The study included fifty patients presented with NSTEMI-ACS underwent cardiac catheterization for coronary angiography to diagnose and evaluate coronary artery disease, among the 50 Patients 34 were male (78%) and 16 were female (22 %). The patients were divided into two groups: Group (1): total number 20, included patients with left main and/or three vessel disease diagnosed by coronary angiography, (15) males and (5) females with mean age and standard deviation of 64.2 ± 11.7 . Group (2): total number 30, included patients without left main nor three vessel disease diagnosed by coronary angiography, (19) males and (11) females with mean age and standard deviation of 53.7 ± 13.3 .

• **Results:** The comparative study among the two groups regarding to the age ,showed statistically significant difference ($p < 0.05$) where patients in group 1 were older than patients in group 2. The other population characteristics were comparable in the two studied groups ($p > 0.05$). In the multivariate logistic regression analysis for variables predicting left main and/or three vessel disease, the maximal QRS duration more than 90ms was the strongest predictor of left main and /or three vessel disease followed by ST-segment elevation in lead aVR of > 0.5 mm.

Conclusion: Despite the development of improved diagnostic strategies, The ECG remains an essential clinical tool for the evaluation of acute coronary syndrome because it is inexpensive, readily available, simple, safe and non invasive. Although electrocardiographic assessment of myocardial ischemia is usually based on ST-segment deviation, QRS prolongation has been showed to be more sensitive than ST-segment changes for the detection of myocardial ischemia.

Key words: Acute coronary syndrome, Diagnosis, Electrocardiography.

INTRODUCTION

Non-ST-segment elevation acute coronary syndrome (NSTEMI-ACS) due to left main coronary artery disease or three vessel disease thrombosis is a catastrophic event associated with poor prognosis and high in hospital mortality. Early recognition and emergent revascularization is vital for survival. An early identification of patients with left main and/or three vessel disease is an important factor in the prognosis and selection of the optimal treatment strategy in patients with NSTEMI-ACS. Because combined antiplatelet therapy with aspirin and clopidogrel improves outcomes in patients with NSTEMI-ACS, current international clinical guidelines for the

management of NSTEMI-ACS recommended the early initiation of clopidogrel plus aspirin. However, such a combination therapy can increase the risk of perioperative bleeding events and the need for blood transfusion in patients undergoing early coronary artery bypass graft surgery (CABG). Therefore, clinicians might withhold treatment with clopidogrel until visualization of the coronary anatomy because concern about operative bleeding in patients likely to require CABG. So, in such patients ,the early initiation of clopidogrel plus aspirin can cause CABG to postponed until these agents have been eliminated. However, delayed treatment with clopidogrel plus aspirin can increase

the risk of cardiac events in patients who do not require CABG^(1,2).

Early(before angiography), accurate, non-invasive identification of patients with left main and/or three vessel disease in whom CABG is most likely to be indicated is thus crucial for deciding whether treatment with clopidogrel should be initiated on admission. Postponing CABG for several days might seriously compromise outcomes. Timing of CABG depends on many factors including severity of coronary lesions, risk of ongoing ischemia, general condition of a patient, bleeding risk associated with upstream antithrombotic therapies, and local logistic factors such as collocation of cardiac surgical services and surgical waiting lists⁽³⁾.

In the present study, we compared the clinical variables of patients with left main and/or three vessel disease on admission with those of patients without it to derive an early simple predictor of left main and/or three vessel disease in patients with NSTEMI.

PATIENTS AND METHODS

This study had been done in cardiology department, faculty of Medicine, Zagazig university during the period from July 2009 to April 2011

A- Patients

The study included fifty patients presented with NSTEMI-ACS underwent cardiac catheterization for coronary angiography to diagnose and evaluate coronary artery disease, among the 50 Patients 34 were male (78%) and 16 were female (22 %).

The patients were divided into two groups:

Group (1) : total number 20, included patients with left main and/or three vessel disease diagnosed by coronary angiography, (15) males and (5) females with mean age and standard deviation of 64.2 ± 11.7

Group (2) : total number 30, included patients without left main nor three vessel disease diagnosed by coronary

angiography, (19) males and (11) females with mean age and standard deviation of 53.7 ± 13.3 .

Inclusion criteria:

Patients with NSTEMI-ACS who were admitted to our coronary care units and fulfilled the following criteria:

- Typical chest discomfort attributed to cardiac ischemia, lasting at least 5 minutes and occurring within 24-hours before hospital admission and involving an unstable pattern of pain ,including rest pain, new onset, severe or frequent angina or accelerating angina.
- Transient elevation of serum creatine kinase-MB(CK-MB) and troponin T levels over the upper limit of normal (24 IU and 0.1 respectively).
- Fully assessable ECG on admission.
- Fully assessable angiographic data within two weeks on average after admission.

Exclusion criteria:

Patients were excluded from our study if one or more of the following criteria were present:

- Patients with left or right bundle branch block.
- Patients with left ventricular hypertrophy.
- Patients with ventricular pacing
- Patients with ventricular pre-excitation.
- Patients with non ischemic cardiomyopathy.
- Patients on antiarrhythmic drugs.
- Patient with non ischemic or atypical chest pain.
- Patients with transient or persistent new ST-segment elevation in leads other than lead AVR(STE-ACS).
- Patients with Q-wave acute myocardial infarction on presentation.
- Recent percutaneous coronary intervention (less than 6 months) or prior CABG.

B-Methods:

1-Complete history taking including :

- Demographic data as name ,age ,sex ,special habits ,drug history and previous hospital admission.

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- Risk factors for coronary artery disease such as:
 - Smoking: patients are classified into smokers or non-smokers.
 - Hypertension documented by one of the following:
 - History of hypertension diagnosed and treated with medication, diet and/or exercise.
 - Blood pressure >140mmHg systolic and/or >90 mmHg diastolic on at least 2 occasions (JNC 7 classification).
 - Blood sugar measurement:
 - Fasting blood sugar (FBS) after 8 hours of fasting.
 - Post prandial blood sugar after 2 hours of eating.
 - Patient is diagnosed to be diabetic when:
 - History of diabetes ,either type I or type II.
 - Fasting blood sugar >126 mg/dl.
 - Two hours post prandial glucose >200 mg/dl (**according to ADA definition**).
 - Lipid profile: measured after 12 hours of fasting and hypercholesterolemia was defined according to NCEP-ATP classification as:
 - Total cholesterol greater than 200 mg/dl, or
 - LDL greater than 130 mg/dl, or
 - HDL less than 40 mg/dl, or
 - Admission cholesterol greater than 200 mg/dl.
 - Family history of ischemic heart disease or premature cardiac death
 - Chest pain, its character ,duration ,radiation and relation to effort.
 - Angina equivalent such as dyspnea ,palpitation or fatigue.

2-Thorough clinical examination including:

- Pulse and blood pressure.
- Neck veins.
- Edema of lower limbs.
- Abdominal and chest examination.
- Cardiac examination including inspection, palpation and auscultation.

3-Electrocardiographic examination:

- Standard 12-lead ECG were recorded on admission at a paper speed of 25 mm/s and an amplification of 10 mm/mv.
- All ECGs were examined by an investigator blinded to all other clinical data .ST-segment shift was measured 80 ms after the J-point for ST-segment depression and 20 ms after this point for ST-segment elevation using the preceding TP segment as the baseline .ST-segment deviation >_0.05 mv in any lead is considered significant.
- QRS duration was measured manually on each ECG that began at the left side of the line of junction of the R or S wave, if there were no Q waves, the measurement was done from the R wave ,if there was an obscure S-wave ending ,the patient was excluded.

4-Serum cardiac troponins:

- Qualitative assay for cardiac specific troponin was performed on admission and 6 hours later if the first set is negative, values considered positive if more than 0.1 ng/ml.
- They appear in serum within 4-8 hours after symptom onset and they remain elevated for as long as 7-10 days post MI.

5-Coronary angiography:

- All patients were studied within two weeks on average after admission in a fasting state and received diazepam 5mg, diphenhydramine 25mg, dexamethazone 0.5mg as premedication ,left sided cardiac catheterization study was done for all patients using retrograde, percutaneous, transfemoral technique. after preparing both inguinal regions with antiseptic solution, the right inguinal region was infiltrated by local anathesia ,the femoral artery was then punctured using a needle ,through which different catheters were inserted.

Statistical analysis:

The data were tabulated and statistically analyzed using Epi-INFO

(2005) and SPSS version-10 software package.

RESULTS

This study is designed as a cross sectional study that was conducted in Zagazig University Hospitals on 50 patients diagnosed as non ST-segment elevation myocardial infarction (NSTEMI) underwent cardiac catheterization for coronary angiography to coronary artery disease, among the 50 patients 34 were males (68.0%) and 16 were females (32.0%), their ages ranged from 31 to 81 years with mean age and standard deviation 53.7±13.3.

The demographic data:

The age of the patients ranged from 47 to 88 with mean age and standard deviation of 64.2±11.7 in group 1, and from 31 to 81 years with mean age and standard deviation of 53.7±13.3 in group 2, the comparative study among the two groups showed statistical significant difference (P<0.05) where patients in group 1 were older than patients in group 2. There were 15 males (75 %) and 5 females (25 %) in group 1 and 19 males (63.6%) and 11 females (36.6%) in group 2, the comparative study among the two groups showed no statistical significant difference (P> 0.05)

Table (1): Personal characteristics of the subjects:

Studied groups Personal characteristics	Group 1 (n=20) Left main and or multiple vessel affected		Group 2 (n=30)left main and or multiple vessel affected	
	No	%	No	%
Age in years:				
< 60	8	40	21	70
≥ 60	12	60	9	30
Mean± SD	64.2± 11.7		53.7± 13.3	
Range	47-88		31-81	
Sex				
Male	15	75	19	63.3
Female	5	25	11	36.6

T test for age=2.8 p=.006 p less than 0.05 = significant

Chi square for sex= 0.75 p=0.386 p more than 0.05 non-significant

B-Risk factors data :

1-Hypertension:

There were (13) hypertensive patients (65%) and (7) non hypertensive patients (35%) in group 1, and (19)

hypertensive patients (66.3%) and (11) non hypertensive patients (36.6%) in group 2, the comparative study among the two groups showed no statistical significant difference (P>0.05).

Table (2): Frequency of hypertension among study groups

Risk factor Hypertension	Group 1 (n=20)		Group 2 (n=30)		Chi-square	P-value
	No	%	No	%		
HTN :						
Negative	7	35	11	36.6	0.014	0.904 NS
Positive	13	65	19	63.3		

2-Dyslipidemia:

There were (8) dislipidemic patients (40%) and (12) non dislipidemic patients (60%) in group 1, and (12) dyslipidemic

patients (40%) and (18) non dyslipidemic patients (60%) in group 2, the comparative study among the two groups showed no statistical significant difference (P> 0.05).

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Table (3): Frequency of dyslipidemia among study groups

Risk factor	Group 1 (n=20)		Group 2 (n=30)		Chi-square	P-value
	No	%	No	%		
Dyslipidemia :						
Negative	12	60	18	60	0.000	0.1000
Positive						NS

3-Diabetes Mellitus:

The study included (9) diabetic patients (45%) and (11) non diabetic patients (55%) in group 1, and (14) diabetic patients (46.6%) and (16) non diabetic

patients (53.3%) in group 2, also the comparative study among the two groups showed no statistical significant difference (P>0.05). regarding to the frequency of DM among the studied groups.

Table (4): Frequency of DM among study groups

Risk factor	Group 1 (n=20)		Group 2 (n=30)		Chi-square	P-value
	No	%	No	%		
DM :						
Negative	11	55	16	53.3	0.013	0.908
Positive	9	45	14	46.6		NS

4-Smoking:

In this study, (11) patients were smokers (55 %) and (9) patents were non smokers (45%) in group 1, while (14) patients were smokers (46.6%) and (16) patients were non smokers (53.3%) in

group 2, the comparative study among the two groups showed no statistical significant difference (P>0.05). regarding to the frequency of smoking among the studied groups.

Table (5): Frequency of Smoking among study groups

Risk factor	Group 1 (n=20)		Group 2 (n=30)		Chi-square	P-value
	No	%	No	%		
Smoking :						
Negative	9	45	16	53.3	0.33	0.564
Positive	11	55	14	46.6		NS

5-Family history:

There were 5 patients (25%) had positive family history of premature ischemic heart disease and 15 patients (75%) did not have positive family history of premature ischemic heart disease in group 1 and there were 10 patients (33.3%)

had positive family history of premature ischemic heart disease and 20 patients (66.6%) did not have positive family history of premature ischemic heart disease in group 2,the comparative study showed no statistical significant difference between the two studied groups (P>0.05).

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Table (6): Frequency of family history among study groups

Risk factor	Group 1 (n=20)		Group 2 (n=30)		Chi-square	P-value
	No	%	No	%		
Family history						
F H :						
Negative	15	75	20	66.6	0.397	0.529 NS
Positive	5	25	10	33.3		

C-Investigations:

1-Electrocardiography:

Regarding to maximal QRS duration ,our study included 19 patients (95%) with QRS duration more than 90ms and 1 patient only (5%) with QRS duration less than 90ms in group 1 while there were 18 patients (60%) with QRS duration more than 90ms and 12 patients (40%) with QRS duration less than 90ms in group 2 ,the

comparative analysis showed that patients in group 1 had a longer QRS duration than patients in group 2 with statistically highly significant difference (P<0.05).

he sensitivity of maximal QRS duration was 95% as a predictor of left main and/or three vessel disease, hile the specificity of maximal QRS duration was 40 % as a predictor of left main and /or three vessel disease.

Table (7): Frequency of QRS duration among study groups

Maximum QRS duration	Group 1 (n=20)		Group 2 (n=30)		Chi-square	P-value
	No	%	No	%		
QRS :						
Negative	1	5	12	40	4.1	.043 S
Positive	19	95	18	60		

Sensitivity of QRS maximum duration= $19/19+1=19/20=95\%$

Specificity = $12/12+18=12/30=40\%$

Regarding to the frequency of ST-segment elevation in lead AVR, here were 17 patients (85%) with ST-segment elevation in lead AVR more than 0.5ml and 3 patients (15%) without ST-segment elevation in lead AVR more than 0.5ml in group 1 while there were 18 patients (60%) with ST-segment elevation in lead AVR more than 0.5ml and 12 patients (40%) without ST-segment elevation in lead AVR more than 0.5ml in group 2 ,the comparative study between the two groups

showed statistically significant difference (P<0.05) where patients with left main and/or three vessel disease had a higher prevalence and a greater magnitude of ST-segment elevation in lead AVR .

The sensitivity of ST-segment elevation in lead AVR as a predictor of left main and /or three vessel disease was 85% while the specificity of ST-segment elevation in lead AVR as a predictor of left main and /or three vessel disease was 43%.

Table (8) : Frequency of ST segment elevation among study groups

ST segment Elevation In AVR	Group 1 (n=20)		Group 2 (n=30)		Chi-square	P-value
	No	%	No	%		
St segment elevation :						
Negative	3	15	13	43.3	4.4	0.035 S
Positive	17	85	17	56.6		

Sensitivity of ST segment elevation= $17/17+3=17/20=85\%$

Specificity = $13/13+17=13/30=43.3\%$

2-Cardiac troponin T:

In this study, all patients presented with non ST-segment elevation myocardial infarction (NSTEMI) and so positive cardiac troponin T-assay in both groups.

The sensitivity of cardiac troponin T-assay as a predictor of left main and/or three vessel disease was 100% while the specificity of cardiac troponin T-assay as a predictor of left main and/or three vessel disease was 0%.

Table (9): Frequency of cardiac enzymes positivity among study

Cardiac enzymes	Group 1 (n=20)		Group 2 (n=30)	
	No	%	No	%
Cardiac enzymes:				
Negative	0	0	0	0
Positive	20	100	30	100

Sensitivity of cardiac Enzyme= $20/20+0=20/20=100\%$

Specificity of cardiac Enzyme= $0/30+0=0/30=0\%$

3-Exercise ECG:

For myocardial ischemia and 8 patient (40%) had negative exercise test for myocardial ischemia in group 1 while in group 2 there were 19 patients (63.3%) had positive exercise test for myocardial

ischemia and 11 patients (36.6%) had negative exercise test for myocardial ischemia ,the comparative study between the two groups showed no statistically significant difference ($P>0.05$).

Table (10): Frequency of exercise ECG among study groups

Exercise ECG	Group 1 (n=20)		Group 2 (n=30)		Chi-square	P-value
	No	%	No	%		
Exercise ECG :						
Negative	8	40	11	36.6	0.057	0.812 NS
Positive	12	60	19	63.3		

4-Echocardiography:

The study included 2 patients (10%) were had positive wall motion abnormality consistent with ischemic heart disease by Echocardiography and 18 patients (90%) did not have wall motion abnormality by Echocardiography in group 1, while in group 2 there were 15 patients (50%) were had positive wall motion abnormality by

Echocardiography and 15 patients (50%) did not have wall motion abnormality by Echocardiography, the comparative analysis between the two studied groups showed highly statistically significant difference ($P<0.05$) where the prevalence of ischemic heart disease by Echocardiography was greater in group 2.

Table (11): Frequency of echo among study groups

ECHO	Group 1 (n=20)		Group 2 (n=30)		Chi-square	P-value
	No	%	No	%		
Echo:						
Negative	18	90	15	50	8.5	0.003
Positive	2	10	15	50		

5-Coronary angiography findings:

This study included 50 patients presented with non ST-segment elevation myocardial infarction ,underwent cardiac catheterization for coronary angiography to diagnose and evaluate coronary artery disease .among the 50 patients ,there were 9 patients (18%) had normal coronary arteries ,14 patients (28%) had one vessel

disease ,16 patients (32%) had two vessel disease and 11 patients (22%) had three vessel disease .

Regarding to the frequency of left main artery affection among the studied sample, there were 39 patients (78%) had normal left main while 11 patients (22%) had left main disease.

Table (12): Frequency of number of vesseles affected among study

Number of vessels	Studied sample (n=50)	
	No	%
0	9	18
1	14	28
2	16	32
3	11	22

Table (13) : Frequency of Left main artery affection among studied sample

Left main artery	Studied sample (n=50)	
	No	%
Normal	39	78
Affected	11	22

Predictors of left main and /or three vessel disease:

In the multivariate logistic regression analysis for variables predicting left main and three vessel disease, maximal QRS duration was the strongest predictor of left main and three vessel disease

(p=0.0057), followed by age and ST-segment elevation in lead AVR respectively. While the other variables as sex, family history, smoking, hypertension, diabetes mellitus and dyslipidemia were not significant predictors of left main or three vessel disease.

Table (14): Multivariate logistic regression analysis for variables predicting left main and number of vessels

variable	score	Df	P-value
QRS duration	7.64	1	0.0057
Age	4.43	1	0.035
ST-segment elevation in AVR	4.42	1	0.035
Sex	0.75	1	0.386
Family history	0.39	1	0.528
Smoking	0.33	1	0.563
Hypertension	0.014	1	0.904
DM	0.013	1	0.907
Dyslipidemia	0.000	1	1.000

Note: B S.E wald df Sig
 2.5 1.09 5.4 1 0.0200

DISCUSSION

Non-ST–segment elevation acute coronary syndrome (NSTE-ACS) account for approximately 2.5 million hospital admission annually worldwide⁽⁴⁾ and represent the majority of admission to coronary care unit⁽⁵⁾.

Non-ST–segment elevation Acute coronary syndrome (NSTE-ACS) due to left main coronary artery or three vessel disease thrombosis is a catastrophic event associated with poor prognosis and high in hospital mortality. Early recognition and emergent revascularization is vital for survival⁽⁶⁾. Because patients with Non–ST–segment elevation ACS are heterogeneous with respect to the pathophysiological mechanisms, the size of the infarction and the amount of jeopardized myocardium , early risk stratification is a fundamental step in the management of this condition⁽⁷⁾.

The natural history of significant stenosis of the left main coronary artery without revascularization treatment is associated with elevated mortality⁽⁴⁾.

Stenosis of LMCA is more frequent in high-risk patients with NSTE-ACS⁽⁸⁾.

Among patients who present with Non-ST–segment elevation ACS , those with left main disease or 3- vessel disease are more likely to undergo coronary artery bypass graft surgery (CABG)⁽⁹⁾.

Because clopidogrel improves clinical outcome, regardless of the

magnitude of risk in patients with NSTE–ACS⁽¹⁰⁾. The American college of cardiology guidelines recommend treatment with a combination of clopidogrel and aspirin on admission for patients with NSTE – ACS who are scheduled to undergo percutaneous coronary intervention or Non-interventional treatment considered a classI indication⁽⁶⁾. However in some patients who require early CABG, this combination therapy may increase the risk of major bleeding⁽¹¹⁾. The administration of clopidogrel within 5 days before CABG has been associated with operative bleeding⁽¹²⁾. It is therefore preferable to withhold clopidogrel until assessment of the coronary anatomy especially in patients who require early CABG.

Early, accurate, non invasive identifications of patients likely to require CABG, such as those with LM or 3-vessel disease, Is thus crucial for deciding whether treatment with clopidogrel should be initiated on admission.

In this study, we compared the variables of patients with left main and/or three vessel diseases on admission with those of patients without it to drive an early, simple prediction of left main and/or three vessel diseases in patients with NSTE-ACS we divided the patients into two groups :

Group (1): Total number 20, included patients with left main and/or three vessel diseases by coronary angiography, 15 males

and 5 females with mean age and standard deviation of 46.2 ± 11.7 .

Group (2): Total number 30, included patients without left main nor three vessel disease by coronary angiography, 19 males and 11 females with mean age and standard deviation of 53.7 ± 13.3 .

Age more than 65, one of the parameter used in TIMI risk score⁽¹³⁾.

In our study we found that age was a significant predictor of left main or three vessel disease, where patients in group 1 (46.2 ± 11.7) were older than patients in group 2 (53.7 ± 13.3). this results is consistent with the study of⁽¹⁴⁾ who found 67 ± 17 years in left main and/or three vessel disease group in comparison to 60 ± 14 years in non left main nor three vessel disease group. And the study of⁽¹⁵⁾ who found 68 ± 11 years in left main group in comparison to 66 ± 8 years in non left main group.

Male gender was non-statistically significant during the comparative study among the two groups which is similar to the study of⁽¹⁶⁾ who found that there were no significant differences in sex.

This is in contrary to the study conducted by⁽¹⁷⁾ who observed a significant association between male gender and left main and/or three vessel disease.

Regarding to hypertension in this study, there were no significant relationship between hypertension and the incidence of left main or three vessel disease, similar to that found by^(18,19) who reported that there were no statistically significant differences in patients who have had hypertension and those who did not. However,⁽²⁰⁾ observed that there is a significant relationship between hypertension and the incidence of left main or three vessel disease.

The standard 12- lead ECG, which is an inexpensive, non-invasive, simple, safe and readily available clinical tool, has a central role in diagnosis and immediate triage for NSTEMI-ACS and early identification of left main or three vessel disease⁽²¹⁾.

Although electrocardiographic assessment of myocardial ischemia is usually based on ST-segment deviation, QRS prolongation has been shown to be more sensitive than ST-segment Changes for the detection of myocardial ischemia⁽¹⁰⁾.

In the present study, we found that QRS duration was strongly associated with left main and/or three vessel disease in patients with NSTEMI-ACS and this is supported by the results of the studies by^(18,19).

Further more, maximal QRS duration of > 90 ms was the most sensitive predictor of left main or three vessel disease which was in consistent with the result of⁽¹⁴⁾ who observed that QRS duration > 90 ms is independent prediction of left main or three vessel disease and increased risk of cardiovascular disease in the long term.

Several mechanisms might account for these findings. first, QRS prolongation is most likely caused by extensive ischemia which results in slow conduction velocity in ischemic areas⁽¹⁶⁾. Such decreased conduction velocity is a consequence of regional hyperkalemia caused by potassium leakage from ischemic cells⁽²⁰⁾. This decreased conduction velocity associated with myocardial ischemia is manifested as QRS prolongation on the surface ECG.

The second possible reason for the strong association between QRS duration and left main and/or three vessel disease is that QRS prolongation might correlate with heart failure. Murkofsky et al reported that a QRS duration of > 100 ms on a standard resting 12 lead ECG was a marker of decreased left ventricular function.

Third, QRS prolongation might reflect a greater amount of infarction⁽²²⁾.

Most pervious studies assessing the clinical significance of the admission ECG in patients with NSTEMI-ACS have focused on ST-segment deviation in leads other than aVR, that is clinicians have used an 11-lead ECG, neglecting lead aVR⁽¹⁷⁾.

Therefore, the clinical significance of ST-segment deviation in lead aVR, in

patients with NSTEMI-ACS remains poorly understood.

Lead aVR should not be considered the forgotten lead. Four specific findings in lead aVR can reflect specific conditions, ST-segment elevation is an indicator of significant left main coronary artery disease, PR-segment elevation in acute cases of pericarditis, R wave in tricyclic antidepressant poisoning and ST-segment elevation suggestive of atrio-ventricular reciprocating tachycardia in pre-excitation syndromes⁽²³⁾.

In the present study, we conclude that ST-segment elevation in lead aVR on admission in patients with NSTEMI-ACS, was useful and significant for identifying patients with left main and/or three vessel disease. Similar to the results conducted by⁽⁵⁾ which reported that ST-segment elevation in lead aVR was highly suggestive of left main and/or three vessel disease in patients with NSTEMI-ACS. on the contrary⁽⁸⁾ found no relationship between ST-segment elevation in lead aVR and left main or three vessel disease.

The possible mechanisms of ST-segment elevation in lead aVR in case of left main and/or three vessel disease can be attributed to its unique position because its positive pole is oriented to the right upper side of the heart. Therefore, lead aVR looks into the left ventricular cavity from the right shoulder (referred to as a cavity lead) and ST-segment elevation in this lead might reflect global subendocardial ischemia. When circumferential ischemia often associated with left main and/or three vessel disease the ST-segment vector is directed to the right shoulder resulting in ST-segment elevation in lead aVR⁽¹⁷⁾.

In this study, Troponin T was found to be a significant independent predictor on multivariate analysis of left main and/or three vessel disease and this is supported by the results of the studies conducted by^(13,19). This may be explained by the fact that elevation of cardiac troponin has been associated with more extensive coronary artery disease, more complex and severe

coronary lesions and a greater burden of intra coronary thrombus on coronary angiography in patients with NSTEMI-ACS as noted by^(21,23).

Regarding to exercise ECG, there was no significant association between the results of exercise ECG and the incidence of left main and/or three vessel disease, similar to that found by⁽²³⁾.

In this study, we found that highly significant association between positive wall motion abnormality by Echocardiography and patients without left main nor three vessel disease. This can be explained by the fact that wall motion abnormality is detected by comparing the affected segments to the other healthy segments⁽²⁴⁾. In patients with left main and/or three vessel disease (diffuse ischemia) all segments of the left ventricle are affected in similar fashion making the detection of segmental wall motion abnormality is difficult.

Finally, in the multivariate logistic regression analysis of this study for variables predicting left main and/or three vessel disease, maximal QRS duration was the strongest predictor of left main and/or three vessel disease followed by age and ST-segment elevation in lead aVR respectively. While the other variables as sex, family history, smoking, hypertension, DM and dyslipidemia were not significant predictors of left main and/or three vessel disease.

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