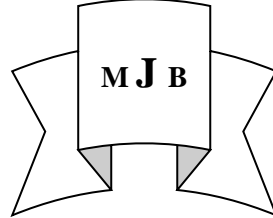


The Significance of ST Segment Elevation in Lead aVR in Acute Anterior Myocardial Infarction

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Abstract

Background and purposes:

lead aVR is an ignored lead in ECG, several studies showed that ST segment elevation in aVR may predict left main stem or 3 vessels disease, and so suggest that ST- elevation in patient with acute anterior myocardial infarction can be predictors for poor prognosis to confirm this; this study was conducted.

Patients and Methods:

100 patients with acute anterior myocardial infarction were divided into two groups; 1st group had ST-segment elevation in lead aVR more than 0.5 mv and other group had no ST-segment elevation in lead aVR. All patients were followed in hospital staying through history, examination ,and investigations for risk factors of coronary vascular disease ,complications, and mortality.

Results:

ST-segment elevation in lead aVR was an important predictor of occurrence of adverse prognosis, it occurred more in patients with increasing age. Also it occurred more in patients with more risk factors for coronary vascular disease including diabetes mellitus ,hypertension ,smoking, and family history of ischemic heart disease.

The study found that the occurrence of complications like shock, post myocardial infarction angina, heart failure, arrhythmia were more in patients with ST-segment elevation in lead aVR . It was also found that mortality rate in patients with acute anterior myocardial infarction with ST-segment elevation in lead AVR of more than 0.5 mv was higher than patients without ST-segment elevation in lead AVR.

Conclusion:

The results of this study showed the significance of ST-segment elevation in lead aVR as important predictors of occurrence of complications in patients with acute anterior myocardial infarction and determination which patient require more intensive care and early referral to invasive treatment.

Key words: acute anterior myocardial infarction ; lead aVR, electrocardiography

أهمية ارتفاع جزء ST في قطب aVR في احتشاء العضلة القلبية الأمامية الحادة

الخلاصة

الخلفية والغرض: aVR قطب مهم في تخطيط القلب، دراسات عديدة أثبتت أن ارتفاع aVR قد يدل على انسداد في الشريان الرئيسي الأيسر أو انسداد ثلاثة شرايين. ارتفاع aVR قد ينبأ بحدوث تعقيدات للمريض في حالة إصابته باحتشاء العضلة القلبية الأمامية الحادة.

الطرائق: تم اخذ عينة تتكون من ١٠٠ مريض مصابون باحتشاء العضلة القلبية الأمامية الحادة وتم تقسيمهم إلى مجموعتين، المجموعة الأولى لديها ارتفاع في جزء (ST) في قطب (aVR) أكثر من ٠,٥ ميلي فولت، والمجموعة الثانية ليس لديها ارتفاع في جزء (ST) في قطب (aVR). وقد تم متابعة المرضى خلال تواجدهم في المستشفى وتسجيل حدوث أي تعقيدات للمرضى أو حدوث الوفاة.

النتائج: ارتفاع في جزء (ST) في قطب (aVR) أكثر من ٠,٥ ميلي فولت عامل مهم للتنبؤ بحدوث تعقيدات في الجلطة القلبية الأمامية الحادة وهي تظهر أكثر عند ارتفاع عمر المريض، وعند إصابته السابقة بقصور الدورة التاجية و داء السكر وارتفاع الضغط والتدخين وامتلاك المريض لتاريخ عائلي للإصابة بقصور الدورة التاجية.

الدراسة استنتجت حدوث تعقيدات أكثر مثل الصدمة القلبية، قصور الدورة التاجية بعد احتشاء العضلة القلبية الحاد، عجز القلب، خفقان القلب وارتفاع الوفاة عند ارتفاع جزء (ST) في قطب (aVR) في إصابة المريض باحتشاء العضلة القلبية الأمامية الحادة.

الخاتمة: هذه الدراسة أثبتت أهمية ارتفاع جزء (ST) في قطب (aVR) في احتشاء العضلة القلبية الأمامية الحادة في التنبؤ بحدوث تعقيدات وارتفاع نسبة الوفاة وتحديد المرضى الذين يحتاجون مراقبة أكثر وتداخل قسطاري أسرع.

Introduction

Acute myocardial infarction is one of most common disease in hospitalized patients. The early (30-days) mortality rate from acute myocardial infarction is ~30% with more than half of these deaths occurring before the stricken individual reaches the hospital [1].

The 12-lead ECG is a pivotal diagnostic and triage tool since it is the center of the decision pathway for management, permits distinction of those patients presenting with ST-segment elevation from those presenting without ST-segment elevation. ST elevation or Q waves in one or more of the precordial leads (V1-V6) and leads I and aVL has traditionally been used to suggest anterior wall ischemia or infarction . [2]

Although the augmented unipolar limb lead aVR was developed more than 60 years ago in order to obtain specific information from the right upper side of the heart, it remains a largely neglected lead for identifying the culprit lesion in clinical practice. [3] This is somewhat surprising as lead aVR may contain important information regarding the prognosis of patient with ischemic myocardium and the location of the culprit lesion. [4]

Lead aVR ST-segment elevation of 0.5 mV or more may prove useful as it is more frequent and pronounced in patients with left main stem when

compare to other coronary lesions. [4]

To determine the significance of ST-elevation in lead aVR in patients with acute anterior myocardial infarction ,whether it is associated with more risk factors and its role in predicting the occurrence of adverse prognosis and complications in these patients this study was carried out.

Patients and Methods

The study was an observation prospective study on one hundred patients whom were admitted to Merjan Teaching Hospital with diagnosis of acute anterior myocardial infarction from January 2010 to October 2010.

History and physical examination were taken from patients regarding age, sex, hypertension (patients were considered hypertensive if they had history of hypertension or blood pressure above 140/90[5]) diabetes (patient considered diabetic if they had history of diabetes or HbA1c \geq 6.5 % or fasting blood sugar \geq 126 mg/dL, or random plasma glucose \geq 200 mg/dL) ,family history of ischemic heart disease, previous history of ischemic heart disease, and history of smoking.

The diagnosis of acute anterior myocardial infarction was based on laboratory feature including elevation of serum troponin, clinical feature included typical ischemic pain, and ECG characteristic of acute anterior

myocardial infarction inform of ST-elevation more than 1mm in limb lead 1,aVL,more than 2mm in chest lead

All patients received thrombolytic therapy and nearly similar treatment.

The study excluded the following patients:

- 1-previous myocardial infarction
- 2-patients whom didn't receive thrombolytic therapy either because they had contraindication or they reached hospital beyond time
- 3-left or right bundle branch block.
- 4-pre-excitation syndrome.
- 5-valvular heart disease.
- 6-inferior myocardial infarction.

The patients were followed in coronary care unit and then in hospital word for prognosis and complications including cardiogenic shock(systolic blood pressure below 90mmHg,cold extremities,low volume pulse, evidence of tissues hypoxia) [6], post myocardial infarction angina (defined as chest pain occurring within 48 hours after an acute MI),heart failure(clinical and echo diagnosis), arrhythmia (tachyarrhythmia including atrial fibrillation, supraventricular tachycardia, ventricular tachycardia, ventricular fibrillation and bradyarrhythmia including rate below 50 beats per minute or heart block), and death.

ECG Evaluation:

Patients were classified into two groups ; those without ST-segment elevation in lead aVR and those with ST- elevation in lead aVR. ST-elevation in lead aVR was considered if there was elevation of ST- segment more than 0.5 mv from base line ; which was calculated 60 ms from J point. [7]

Statistical Analysis

Analysis of variant was used to calculate P- valve for continuous variable Chi square analysis was used to consider compare categorical variable Difference were statistically

significant at $P < 0.05$.

Results

Hundred patients with acute anterior myocardial infarction were included in the study,43 patients(43%) had ST-segment elevation in lead aVR and 57 patients(57%) without ST-segment elevation in lead aVR. The mean age of all patients was 56 ± 11 years.

The mean age was more in patients with ST- segment elevation in lead aVR than patients without ST- segment elevation in lead aVR. The mean age of patients with ST- segment elevation in lead AVR was 61 ± 11 years, while the age of patients without ST-segment elevation was 53 ± 11 years. The p- valve was 0.041 which was significant(as shown in table1).

Regarding gender; patients with ST- segment elevation in lead aVR were 29 males and 14 females while there was 36 males and 27 females in patients without ST elevation in aVR ,the p value was 0.06 which was not significant (as shown in table 1).

Patients with ST- segment elevation in lead aVR had more risk factors than patients without ST-segment elevation in lead aVR. In patients with ST- segment elevation in lead aVR; hypertension was present in 27 (62.7%) patients, diabetes 30(69.7%) patients, smoking 20(46.5%) patients and, family history of ischemic heart disease 22(51.1%) patients.

While patients without ST-segment elevation in lead aVR hypertension was present in 24(42,1%) patients, diabetes 20(35%) patients ,smoking 15 (26.3%) patients ,and family history of ischemic heart disease 18(31.5%) patients, P- valve :0.04, 0.01, 0.03, 0.04 respectively which was statistically significant (as shown in table one).

The complications were more in

patients with ST- segment elevation in lead aVR. Shock developed in 12(27.9%) patients ,post myocardial infarction angina 25(58.1%) patients, heart failure 19(44.1%) patients, and arrhythmia 14(32.5%) patients.

while patients without ST-elevation shock occurred in 6(10.5%) patients, post infarction angina in 20(35%) patients, heart failure in 12(21%) patients, arrhythmia 9(15.7%) patients p: values was 0.026, 0,02,

0.013, 0,04 respectively which was statistically significant (as shown in table two).

The mortality was more in patients with ST- segment elevation in lead aVR; there was 13(30.2%) patients dead, while the mortality in patient without ST- elevation was 7(12.2%) patients p value was 0.026 which was statistically significant (as shown in table three).

Table 1 The correlation between ST- segment in lead aVR with demographic features, and risk factors

Risk factor	ST. Elevation in aVR No:43	Non ST. elevation in aVR No:57	P. Valve
Age(years)	61±11	53±11	0.041
Gender(male)	29(67.4%)	36(63.1%)	0.06
Hypertension	27 (62.7%)	24 (42.1%)	0.04
Diabetes	30 (69.7%)	20 (35%)	0.01
Smoking	20 (46.5%)	15 (26.3%)	0.03
Family History of ischemic heart disease	22 (51.1%)	18 (31.5%)	0.04

Table 2 The relation between ST- segment in lead aVR with complications

complication	ST. Elevation No:43	Non ST. elevation No:57	P. Valve
Shock	12 (27.9%)	6 (10.5%)	0.026
Post myocardial infarction angina	25 (58.1%)	20 (35%)	0.02
Heart Failure	19 (44.1%)	12 (21%)	0.013
Arrhythmias	14 (32.5%)	9 (15.7%)	0.04

Table 3 The relation between ST-segment in lead aVR with mortality

Variable	ST. Elevation No:43	Non ST.elevation No:57	P. Valve
Death	13 (30%)	7 (12%)	0.026

Discussion

This study found that ST- segment elevation in lead aVR in acute anterior myocardial infarction was associated with more risk factors including increasing age ,diabetes, smoking, hypertension and family history of ischemic heart disease than patients without ST- segment elevation in lead aVR . Also the study found that patients with ST- segment elevation in aVR in acute anterior myocardial infarction had more complications including more patients developed shock, post myocardial angina, heart failure, tachy or brady arrhythmia than without ST- elevation in lead aVR ..

The right upper side of the heart that is the outflow tract of the right ventricle and the basal part of the interventricular septum, is supplied by the main stem of the left coronary artery and/or branches from the proximal parts of the left anterior descending artery; hence lesions in these coronary segments cause ST-segment elevations in lead aVR, due to the dominance of the basal ventricular mass, this should lead to augment elevation in lead aVR, as the ST-segment vector in the frontal plane points in a superior direction. [8]

It was shown in both the experimental laboratories and in clinical studies that a sudden obstruction of a left main coronary artery induces an increase of the end diastolic pressure without increasing the end diastolic volume, thus shifting the pressure/volume curve upright. The sudden increase of the end diastolic pressure reduces the subendocardial coronary flow, resulting in a circumferential subendocardial ischemia. The electrical vector is shifted from the epicardium toward the subendocardium, causing diffuse ST depression with inverted T waves in the precordial leads on the surface ECG. Lead aVR faces the cavity of the

left ventricle from a right superior axis and thus records a mirror image of the apical leads V5 and V6. Hence, if there is ST depression in leads V5 and V6, lead aVR will usually show ST elevation [9]. It is certainly reasonable to theorize that acute occlusion of left main stem causes ischemia of the basal part of the septum through disturbance of the major septal branch blood flow- that is, interruption of the proximal left anterior descending artery blood flow. This would account for lead aVR - segment elevation associated with acute left main stem obstruction[9]

The mortality rate in patients with acute anterior myocardial infarction with ST- segment elevation in lead aVR was more than patients without ST- segment elevation in lead aVR; approximately 30% . The explanation for this conclusion is that patients with ST- segment elevation in lead aVR had more incidence of culprit lesion in left main stem or 3 vessels disease including proximal occlusion of left anterior descending[9], and since left main stem or 3 vessels are supplying a large part of the myocardium of the left ventricle and its acute obstruction thus causes severe hemodynamic deterioration, frequently resulting in rapid fatality, this also explain the occurrence of more complications in patients with ST segment elevation in lead aVR like shock, heart failure ,arrhythmia, and also explain the association with more risk factors for those patients [10].

In most studies Lead aVR showed ST- segment elevation in occlusion of left main stem [11]. 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. [11]

Kosuge et al undertook a similar study to identify an early, simple, and noninvasive predictor of left main stem or 3-vessel disease in patients presenting with acute coronary syndrome. He performed a retrospective analysis of the ECGs of 310 patients diagnosed as ST-segment elevation acute myocardial infarction who later underwent coronary angiography. Multivariate analysis of the ECG findings determined ST-segment elevation greater than 0.5 mm in lead aVR to be the strongest predictor of left main stem or 3-vessel disease, superior to the presence of ST-segment depression in other leads. Statistical analysis of this finding revealed a sensitivity of 78%, a specificity of 86%, a positive predictive value of 57%, and a negative predictive value of 95%. This reasonably high sensitivity allows the clinician to "rule-in" left main stem in the acute coronary syndrome patient with lead aVR ST-segment elevation. [12]

Additional prognostic information is obtained from lead aVR as noted by the work of Barrabes et al, Barrabes examined the prognostic significance of this finding by studying the initial ECG in 775 consecutive patients admitted with their first acute myocardial infarction. Barrages found that in-hospital mortality increased in a stepwise fashion across increasing increments of ST-segment elevation in lead aVR. Of the study population of 775 patients, only 9.4% of the 525 patients without ST-segment elevation in lead aVR died, whereas 26.8% of the 116 patients with 0.05 to 0.1 mV of elevation died, and 44.5% of the 59 patients with greater than 0.1 mV elevation died. [13]

Upon multivariate analysis, ST-segment elevation in lead aVR was the only variable from the initial ECG that was strongly associated with in-

hospital recurrent ischemic events and heart failure, and was retained as an independent predictor of death. Barrages therefore concluded that the worse outcomes in these patients should influence physicians to seek an early invasive approach in the treatment of patients with these ominous electrocardiograph findings. [14]

Yamaji et al, reported a novel electrocardiography (ECG) sign for prediction of acute ischemia caused by left main coronary artery obstruction. They found that ST elevation in lead aVR with less ST-segment elevation in lead V1, is a predictor of left main stem obstruction. This study found that most patient with ST-segment elevation in lead aVR were more likely to require early invasive treatment and in 1st 30 days post acute myocardial infarction develop more complications including shock, heart failure and post acute myocardial infarction angina. [15]

Conclusion

The result of this study found that ST-segment elevation in lead aVR had an important predictors of occurrence of adverse prognosis in patients with acute anterior myocardial infarction and found that ST-segment elevation in lead aVR was associated with increase age, and more risk factors like diabetes, hypertension, smoking, and family history of ischemic heart disease high risk of occurrence of complication like shock, heart failure, arrhythmia, post myocardial infarction angina and high rate of mortality.

Recommendation

1-lead aVR should be strongly considered in patients with acute anterior myocardial infarction.

2- Patients with acute anterior myocardial infarction who have ST-segment elevation in lead aVR more

than 0.5 mv should receive more intensive care, longer staying in coronary care unit and early referral to intensive treatment including early revascularization.

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