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The clinical significance of
lead aVR in non-ST elevation
acute coronary syndrome

조선대학교 대학원

의 학 과

하 성 일

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비 ST분절 상승형 급성 관동맥 증후군에 있어
유도 aVR의 임상적 의의에 대한 연구

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초록

비 ST분절 상승형 급성 관동맥 증후군에 있어 유도 aVR의 임상적 의의에 대한 연구

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(목적) 급성 관동맥 증후군은 비 ST분절 상승형 급성 관동맥 증후군, ST분절 상승형 심근경색으로 크게 나뉘 볼 수 있는데, 치료는 둘 사이에 큰 차이를 보인다. 즉 빠른 재관류술의 필요 유무를 결정하는 것이 중요하며 12유도 심전도가 이러한 진단의 첫걸음이다. 그런데 12유도 중 유독 유도 aVR의 중요성이 간과되어 왔지만 근래에는 관상동맥 질환의 중증도와 관련하여 그 중요성이 대두되고 있다. 따라서 본 연구에서는 비ST분절 상승형 급성 관동맥 증후군 환자에서 관상동맥 질환의 중증도의 예측과 관련한 유도 aVR의 임상적 의의에 대해 연구하고자 하였다.

(방법) 2007년 1월부터 2010년 3월까지 조선대학교 병원에 내원하여 비ST분절 상승형 급성 관동맥 증후군의 진단기준을 만족하는 352명의 환자를 대상으로 분석을 실시하였다. 12유도 심전도상 의미있는 유도 aVR의 ST분절 상승은 TP 분절을 기준으로 0.5mm 이상인 경우로 정의하였다. 관상동맥 조영술 결과상 임상적으로 의미 있는 협착 소견은 협착 주변의 정상 혈관 직경과 비교하여 직경이 50%이상 좁아져 있는 것으로 정의하였으며 병변의 위치 및 갯수에 따라 각각 1혈관 질환, 2혈관 질환, 3혈관 질환으로 구분하였고, 좌주간부에 의미 있는 협착이 있는 경우

에는 1혈관, 2혈관, 3혈관 질환의 동반 여부에 관계없이 좌주간부 병변으로 구분하였다. 유도 aVR의 ST분절 상승 여부에 따라 2군으로 나누어 유도 aVR의 상승 여부에 따른 환자의 임상적 데이터 및 관상동맥 조영술 결과와의 관계에 대해 후향적인 방법으로 분석하였다.

(결과) 352명의 비ST분절 상승형 급성 관동맥 증후군 환자 중 유도 aVR에서 ST분절이 상승한 경우는 총 21명이었다. 유도 aVR에서 ST분절 상승군 및 비상승군 사이에 연령 및 성별간 차이는 없었다. 또한 양군간에 고혈압, 당뇨병, 고지혈증 및 흡연 등의 심혈관계 위험인자의 차이도 없었다. 유도 aVR에서 ST분절이 상승한 군에서 비ST분절 상승형 심근경색의 빈도가 더 높았으며, ST분절 상승이 없는 군에서는 불안정형 협심증의 빈도가 더 높았다. 유도 aVR의 ST분절 상승군에서 관상동맥 우회술을 시행하도록 한 경우가 더 많았지만 양군간에 관상동맥 중재술을 시행한 빈도에서는 차이를 보이지 않았다. 관상동맥조영술 결과를 가지고 비교해볼 때, 유도 aVR의 ST분절 상승군에서 좌주간부 병변의 빈도가 더 높았으며 이는 통계적으로 유의하였다.

(결론) 본 연구에서는 비 ST분절 상승형 급성 관동맥 증후군 환자에서 내원 당시 심전도상 유도 aVR의 ST분절 상승 여부가 비 ST분절 상승형 심근경색 및 좌주간부 병변의 위험성이 있음을 예측하는데 의의가 있음을 보여주었다. 비록 실제 임상에서 심전도상 유도 aVR을 무시하는 경우가 있지만 기존의 연구 및 본 연구를 통해서 보면 유도 aVR은 비 ST분절 상승형 급성 관동맥 증후군과 관련하여서 많은 임상적 의의를 가지고 있기 때문에 그 중요성 및 유용성을 알고 실제로 간과하지 말아야 할 것이다.

핵심 단어 : 비 ST분절 상승형 급성 관동맥 증후군, 유도 aVR

I. Introduction

Patients with non-ST segment elevation acute coronary syndrome(NSTE-ACS) comprise a heterogenous group with a variable prognosis¹⁾. The admission electrocardiogram(ECG) plays a pivotal role in early risk stratification¹⁻²⁾, which is a critical step in the effective management of these patients. Previous studies have demonstrated that even minor ST depression($\geq 0.5\text{mm}$) on the admission ECG is a powerful adverse prognosticator that warrants aggressive medical therapies and early invasive management³⁻⁷⁾. Accordingly, current practice guidelines recognize ST depression as an important high-risk feature¹⁾. Because lead aVR is considered to provide reciprocal information from the left lateral leads on the ECG, it is often ignored in clinical practice⁸⁾. Several single-center studies have shown that compared to ST depression in other leads, ST elevation in lead aVR is a better predictor of adverse events in patients with NSTE-ACS⁹⁻¹⁰⁾. It has been also suggested that ST elevation in lead aVR is a useful indicator of left main or 3-vessel disease(LM/3VD), thereby guiding the appropriate choice of initial antithrombotic therapies and the triage of these high-risk patients who may require urgent surgical revascularization¹¹⁻¹³⁾.

In this study, we compared the clinical variables of patients with ST elevation in lead aVR on admission ECG with those of patients without it to confirm the clinical significance of lead aVR in patients with NSTE-ACS.

II. Methods

1. Patients

We retrospectively studied 352 consecutive patients who were admitted to Chosun University Hospital between January 2007 and to March 2010 and fulfilled the following the criteria of NSTEMI-ACS: (1) Unstable angina was defined as chest pain which occurred within 1 month, during rest or with increased severity and without elevation of cardiac enzyme or transient elevation within 3 times of upper normal limit. (2) Non-ST segment elevation myocardial infarction(NSTEMI) was defined as chest pain lasting more 30 minutes accompanied by elevated cardiac enzyme over 3 times of upper normal limit(Analyzed with Cobas®, Roche Diagnostics, Indianapolis, IN, USA) but without ST segment elevation in leads other than lead aVR.

2. Electrocardiogram

A 12-lead electrocardiogram was recorded on admission at a paper speed of 25mm/s and an amplification of 10mm/mV. ST-segment shifts were measured 20ms after the J point for ST-segment elevation using the preceding TP segment as a baseline¹⁴⁾. Because ST segment elevation in lead aVR of only 0.5mm has been related to poor outcomes in NSTEMI-ACS¹⁴⁾, ST segment elevation of ≥ 0.5 mm in lead aVR was defined as being clinically significant.

3. Coronary angiography

All patients underwent coronary angiography. A stenosis was considered significant when the reduction in diameter in any projection was equal to or greater than 50% of the adjacent normal diameter of left main coronary artery(LMCA) or equal to or greater than 50% of the adjacent normal diameter of other major epicardial coronary arteries. Subjects were classified as having

left main coronary artery disease, one, two or three-vessel disease. Any patient who had significant stenosis in left main coronary artery was considered as having left main coronary artery disease even if he or she had concomitant one, two or three vessel diseases.

4. Statistical Analysis

Statistical analysis was performed using a commercially available computer program (SPSS 12.0 for Windows, SPSS Inc. Chicago, IL, US). The variables were presented as means \pm SDs for continuous data and as proportions for categorical data. Continuous variables with normal distribution were analyzed by Student *t*-test. Categorical parameters were analyzed by Chi-square or Fisher's exact test whichever appropriate. Two-sided *p* values < 0.05 were considered significant.

III. Results

1. Demographic characteristics of the study patients

The baseline demographic characteristics of the patients are shown in Table 1. ST elevation in lead aVR was present 21 patients(6.0%). The mean age of lead aVR(-) group was 63.2 ± 10.9 years-old and that of lead aVR(+) group was 64.0 ± 10.8 years-old. The presence of lead ST segment elevation in lead aVR was not associated with age, major cardiovascular risk factors(hypertension, diabetes, hyperlipidemia and smoking) and gender ($P > 0.05$).

2. Clinical characteristics of the study patients

The clinical characteristics of the patients are shown in Table 2. Patients with elevated ST segment in lead aVR had a higher prevalence of NSTEMI($P < 0.001$). But, patients without elevated ST segment in lead aVR had a higher prevalence of UA($P < 0.001$). Lead aVR positivity was associated with higher systolic blood pressure($P < 0.05$), otherwise there was no differences in diastolic blood pressure, heart rate and ejection fraction between two groups($P > 0.05$, respectively). There was no difference in prevalence of patients who had undergone percutaneous coronary intervention(PCI) between two groups. In contrast, the prevalence of patients who had been recommended to undergo coronary bypass surgery was significantly higher in lead aVR(+) group than in lead aVR(-) group($P < 0.01$)

3. Coronary angiographic characteristics of patients

0 vessel disease was observed 28.7% of the patients; 1 vessel disease, in 24.4%; 2 vessel disease, in 17.6%; 3 vessel disease, in 25.9%; and LM disease, in 3.4%. Whereas 0 vessel disease was more prevalent in the lead aVR(-) group, left main disease was more prevalent in the lead aVR(+)

group, which was statistically significant(Table 3).

IV. Discussion

ECG is a valuable noninvasive diagnostic method for detection of NSTEMI-ACS. In addition, it has an important role in the management of NSTEMI-ACS such as emergent percutaneous coronary intervention or coronary bypass surgery¹⁵⁾. In NSTEMI-ACS, acute myocardial infarction from critical left main stenosis has very high mortality even after early rapid medical treatment and needs percutaneous coronary intervention or coronary bypass surgery¹⁶⁾. The ability to predict the culprit lesion by interpreting ECG prudently is very important in the NSTEMI-ACS, especially in acute left main myocardial infarction.

Many clinical practitioners learn and interpret the ECG, but unfortunately, lead aVR has been largely ignored by electrocardiographers until recent years¹⁷⁾.

This was partly because of the belief that lead aVR reflected reciprocal changes in the lateral part of the heart derivations (aVL, V5, and V6)⁸⁾.

Gorgels and Colleagues¹⁸⁾ reported that ST elevation in lead aVR indicated left main coronary artery lesion or 3-vessel disease in patients with unstable angina pectoris. Similarly, Barrabes and colleagues reported that an ST elevation of 1mm or greater indicated left main coronary artery lesion or 3-vessel disease in patients with NSTEMI⁹⁾.

In our study, the prevalence of NSTEMI was higher in patients with NSTEMI-ACS in whom ST segment in lead aVR were elevated. It means that the clinicians should not miss ST segment elevation in lead aVR when interpreting ECG in patients with NSTEMI-ACS. By Choi's case report in 2009¹⁹⁾, there was critical left main coronary artery disease which was treated with drug-eluting stent in patients with NSTEMI in whom ST segment in lead aVR was elevated. Therefore, the ECG of patients with NSTEMI-ACS should be interpreted carefully about lead aVR, as shown by our study and by above case report. Overall, If there is lead aVR ST segment elevation in patients

with NSTEMI-ACS, we can predict that the patients may have NSTEMI before the result of cardiac enzyme comes out and manage them with early and appropriate therapy.

By Rostoff's study performed in 150 patients with acute coronary syndrome comparing the relationship between elevation in lead aVR and left main stenosis, ST segment elevation in lead aVR was 69.6% in left main stenosis than in other coronary lesion which showed only 34.6%¹⁸⁾. Left main disease had a higher prevalence in patients with ST segment elevation in lead aVR in our study, which result is consistent with that of previous studies and means that if there is lead aVR ST segment elevation in the ECG of patient with NSTEMI-ACS, we can predict early the patient may have left main disease before performing coronary angiography and plan how to perform PCI. In critically ill patients with NSTEMI-ACS in whom ST segment of lead aVR is elevated, it is evident that clinicians should have emergent coronary angiography because of the possibility of severe left main disease.

The prevalence of patients who had been recommended to undergo coronary bypass surgery was significantly higher in lead aVR(+) group than in lead aVR(-) group. That means ST segment elevation in lead aVR predicts severe coronary artery diseases that require surgical revascularization than percutaneous coronary intervention.

The possible mechanism of ST segment elevation in lead aVR is in the basal part of the interventricular septum in the left main stenosis. The relationship between acute myocardial infarction from left main stenosis and elevation of lead aVR is decided by whether the origin of septal branch supplying blood to the basal part of the interventricular septum is in the left main coronary artery or not, that is, if the basal part of the interventricular septum develops ischemia because blood supply disorder in septal branch occurs due to left main stenosis, ST segment elevation in lead aVR is

observed in the ECG⁸⁾.

By Pahlm's study, most of 35 ECG interpreters who were requested to interpret the ECG in which the lead aVR was omitted or measured incorrectly, didn't pay attention to the lead aVR²⁹⁾. Many physicians in our hospital didn't know clinical significance of lead aVR. In addition, they even didn't pay attention to lead aVR same as the result of Pahlm's study.

V. Conclusion

Our study suggests that ST segment elevation in lead aVR on admission are useful for predicting the risk of NSTEMI and left main disease in patients with NSTEMI-ACS. Although Lead aVR in the interpretation of ECG is often ignored in real clinical practice, it has many clinically diagnostic informations. In addition to NSTEMI-ACS, lead aVR can be used to diagnose acute pericarditis, tricyclic antidepressant poisoning, preexcitation syndrome-related narrow complex tachycardia²⁰). We should know the usefulness and importance of lead aVR in the clinical practice and should not consider it as a forgotten lead.

In conclusion, our study is intended to report the clinical significance of lead aVR in the NSTEMI-ACS and not to ignore it when interpreting ECG in these patients.

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Table 1. Demographic characteristics of the study patients

	aVR(+) (n = 21)	aVR(-) (n = 331)	p-value
Age	64.0 ± 10.8	63.2 ± 10.9	p > 0.05
Male	13(61.9%)	201(60.7%)	p > 0.05
Female	8(38.1%)	130(39.3%)	p > 0.05
Hypertension	15(71.4%)	158(47.7%)	p > 0.05
Hyperlipidemia	7(33.3%)	63(19.0%)	p > 0.05
Diabetes	8(38.1%)	95(28.7%)	p > 0.05
Smoking	8(38.1%)	133(40.2%)	p > 0.05

Table 2. Clinical characteristics of the study patients

	aVR(+) (n= 21)	aVR(-) (n= 331)	p-value
Unstable angina	5(23.8%)	256(77.3%)	p < 0.001
NSTEMI	16(76.2%)	75(22.7%)	p < 0.001
PCI	9(42.9%)	152(45.9%)	p > 0.05
CABG	6(28.6%)	20(6.0%)	p < 0.01
SBP(mmHg)	134.8 ± 25.2	125.6 ± 19.3	p < 0.05
DBP(mmHg)	82.9 ± 15.9	77.4 ± 11.4	p > 0.05
HR(/min)	83.1 ± 19.2	75.1 ± 13.3	p > 0.05
EF	59.1 ± 10.0	63.6 ± 10.4	p > 0.05

SBP = systolic blood pressure, DBP = diastolic blood pressure, HR = heart rate,

EF = ejection fraction, PCI = percutaneous coronary intervention, CABG = coronary artery bypass graft

Table 3. Coronary angiographic characteristics of patients

	aVR(+) (n= 21)	aVR(-) (n= 331)	p-value
0 vessel disease	0(0.0%)	101(30.5%)	p < 0.01
1 vessel disease	6(28.6%)	80(24.2%)	p > 0.05
2 vessel disease	3(14.3%)	59(17.8%)	p > 0.05
3 vessel disease	8(38.1%)	83(25.1%)	p > 0.05
Left main disease	4(19.0%)	8(2.4%)	p < 0.01