ST-Segment Depression in Lead aVR*

A Useful Predictor of Impaired Myocardial Reperfusion in Patients With Inferior Acute Myocardial Infarction

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Study objective: **During inferior acute myocardial infarction (AMI), the ECG lead aVR is frequently ignored, and therefore its clinical significance remains unclear. We examined the relation between ST-segment deviation seen in lead aVR on ECGs obtained at hospital admission and myocardial reperfusion in patients who have experienced recanalized inferior AMIs.**
Design and setting: **Retrospective study.**
Patients: **A total of 225 patients with inferior AMIs in whom Thrombolysis in Myocardial Infarction grade 3 flow was achieved within 6 h after symptom onset.**
Measurements and results: **Patients were classified as follows according to ST-segment deviation in lead aVR on an ECG obtained at hospital admission: group A, 103 patients with no ST-segment depression; group B, 80 patients with ST-segment depression of ≤ 1.0 mm; and group C, 42 patients with ST-segment depression of > 1.0 mm. There were no differences in time from symptom onset to hospital admission or in the culprit lesion among the three groups. The degree of ST-segment elevation in leads II, III, aVF, V5, or V6, the degree of ST-segment depression in leads V1 to V4, and the sum of ST-segment deviation in these leads were lowest in group A and highest in group C. In groups A, B, and C, the incidence of impaired myocardial reperfusion, defined as myocardial blush grade 0/1, was 2%, 23%, and 67%, respectively ($p < 0.001$). The sensitivity and negative predictive values of ST-segment depression in lead aVR for impaired myocardial reperfusion were higher than those based on other ECG variables. Multivariate analysis showed that the degree of ST-segment depression in lead aVR was an independent predictor of impaired myocardial reperfusion (odds ratio 8.41; 95% confidence interval, 2.96 to 23.9; $p < 0.001$).**
Conclusions: **We conclude that the degree of ST-segment depression in lead aVR is a useful predictor of impaired myocardial reperfusion in patients who have experienced inferior AMIs.**
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Key words: ECG; myocardial infarction; ST segment

Abbreviations: AMI = acute myocardial infarction; LCX = left coronary circumflex artery; RCA = right coronary artery; TIMI = Thrombolysis in Myocardial Infarction

During inferior acute myocardial infarction (AMI), ECG lead aVR is frequently ignored, but some investigators have suggested that this lead can provide ECG information that is useful for the characterization of inferior AMI, which is more often caused by the right coronary artery (RCA) occlusion than by the left coronary circumflex artery (LCX) occlusion. Menown and Adgey[1] reported that the display of lead aVR in an inverted format as lead −aVR improves the ECG classification of inferior or lateral AMI. Nair and Glancy[2] reported that ST-segment depression in lead aVR is useful for identifying the RCA or the LCX as the culprit artery in patients with inferior AMIs. However, the clinical significance of ST-segment depression in lead aVR remains unclear in patients with recanalized inferior AMIs. In the reperfusion era, the evaluation of myocardial reperfusion using myocardial blush grading has been reported to be useful in stratifying the prognosis of patients with recanalized AMI.[3–5]

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Therefore, we examined the relation between the degree of ST-segment depression found in ECG lead aVR and myocardial reperfusion in patients with inferior AMIs.

Materials and Methods

Study Group

We enrolled 225 consecutive patients with inferior AMI (mean [± SD] age, 63 ± 11 years; 172 men and 53 women) who fulfilled the following criteria for study inclusion: (1) no history of myocardial infarction or of other types of heart disease except for coronary artery disease; (2) absence of conditions precluding the evaluation of ST-segment changes on the ECG (*eg*, left bundle branch block, right bundle branch block, and ventricular pacing); (3) achievement of successful recanalization (Thrombolysis in Myocardial Infarction [TIMI][6] grade 3) of the RCA or the LCX as confirmed by coronary angiography within 6 h from symptom onset; and (4) adequate assessment of myocardial blush grade[5] after recanalization. Patients with cardiogenic shock and those with reocclusion of the infarct-related artery during hospitalization were excluded from the study. The diagnosis of inferior AMI was based on typical chest pain lasting ≥ 30 min, ST-segment elevation of ≥ 1 mm in two or more inferior leads (*ie*, II, III, or aVF), and a typical increase in the serum creatine kinase level to more than twice the upper limit of normal.

Coronary Angiography

Coronary angiography was performed with informed consent immediately after hospital admission. The angiograms were evaluated by two observers who were blinded to all other data. Anterograde flow in the infarct-related artery was evaluated on a scale of 0 to 3 according to the standard TIMI flow grade, and recanalization was defined as the establishment of TIMI grade 3 flow. Collateral flow to the infarct zone was graded on a scale of 0 to 3 as described by Rentrop et al.[7] A good collateral channel was defined as grade 2 or 3 flow, and a poor collateral channel as grade 0 or 1 flow. The allocation of recanalization therapy was left to the discretion of the doctor. On angiograms obtained immediately after recanalization, the extent of perfusion territory of the infarct-related artery was quantified according to the angiographic distribution score proposed by Wong et al[8] All left ventricular branches of the RCA and the LCX were scored as follows: branches with a length equivalent to > 80% of that of the largest posterior descending artery were scored as 2; branches with a length between 50% and 80% of the artery were scored as 1; and small branches with a length of < 50% of the artery were scored as 0. The angiographic distribution score was defined as the ratio of the summed score of the infarct-related artery (*ie*, the RCA or the LCX) to the total summed score of the RCA and the LCX. In addition, myocardial blush was graded as follows: 0, no myocardial blush or contrast density; 1, minimal myocardial blush or contrast density; 2, moderate myocardial blush or contrast density, but less than that obtained during angiography of a contralateral or ipsilateral non-infarct-related coronary artery; and 3, normal myocardial blush or contrast density, comparable to that obtained during angiography of a contralateral or ipsilateral non-infarct-related coronary artery.[5] When myocardial blush persisted, this finding was graded as 0.

ECG Analysis

A 12-lead ECG was recorded on hospital admission at a paper speed of 25 mm/s and an amplification of 10 mm/mV. The isoelectric line was defined as the level of the preceding TP segment. ST-segment deviation was measured manually to the nearest 0.5 mm, 20 ms after the end of the QRS complex by two independent observers who were blinded to all clinical and angiographic findings. The degree of ST-segment elevation in leads II, III, aVF, V5, or V6 and the degree of ST-segment depression in leads V1 to V4 were calculated. The right ventricular leads (*ie*, V3R and V4R) were recorded in 200 patients (89%) on hospital admission. ST-segment elevation of ≥ 1.0 mm in the right ventricular lead was defined as being clinically significant.[9]

Cardiac Enzyme Study

Blood samples were obtained on hospital admission, and at 3-h intervals during the first 24 h, at 6-h intervals for the next 2 days, and then daily until hospital discharge.

Statistical Analysis

The data are expressed as the mean ± SD for continuous variables and as percentages for categoric variables. We made comparisons by one-way analysis of variance for continuous variables, and the statistical significance of differences was calculated by using the Scheffé F test. χ^2 analysis or Fisher exact test was used to compare categoric variables. The cutoff point of ECG variables for predicting impaired myocardial reperfusion, defined as myocardial blush grade 0 or 1, was obtained using their receiver-operating characteristic curve. Multiple logistic regression analysis was used to examine the determinants of impaired myocardial reperfusion. The variables used for analysis included age, sex, absence of previous angina within 24 h before AMI, Killip class on hospital admission, TIMI flow grade 0 at initial coronary angiography, multivessel disease, percutaneous coronary intervention, the infarct-related artery, good collateral channel, time from symptom onset to hospital admission, and the degree of ST-segment depression in lead aVR. Odds ratios and 95% confidence intervals were calculated. A two-tailed p value of < 0.05 was considered to indicate statistical significance. Analyses were performed with the use of a statistical software package (SPSS for Windows; SPSS; Chicago, IL).

Results

Patient Characteristics

Patients were divided into the following three groups according to ST-segment deviation in lead aVR on the ECG obtained at hospital admission: group A, 103 patients with no ST-segment depression; group B, 80 patients with ST-segment depression of ≤ 1.0 mm; and group C, 42 patients with ST-segment depression of > 1.0 mm (Fig 1). The baseline characteristics of the three groups are summarized in Table 1. There were no differences among the three groups in age, hemodynamics or Killip class on hospital admission, percutaneous coronary intervention, time from symptom onset to hospital admission, coronary risk factors, or medication received before the occurrence of AMI. Group A patients were less likely to be men. Previous angina within 24 h before occurrence of the AMI was slightly but not significantly less frequent in group C.