

Value of the ST-T Segment in Lead V₄R in Inferior Wall Acute Myocardial Infarction to Predict the Site of Coronary Arterial Occlusion

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The treatment of acute myocardial infarction (AMI) has changed dramatically with the introduction of thrombolytic therapy, immediate angioplasty and emergency coronary artery bypass surgery. Several studies¹⁻³ have shown that the success rate of these procedures depends on the time interval between the onset of complaints and the achievement of reperfusion. In patients admitted with an inferior wall AMI, the coronary artery causing the AMI can be the right or the left circumflex artery. Our previous investigations, as well as those of others,⁴⁻⁶ have shown that the recording of lead V₄R in the acute phase of an inferior wall AMI can distinguish those patients with a proximal occlusion of the right coronary artery from those with an occlusion of the distal right or left circumflex artery, the first group of patients showing ST-T-segment elevation ≥ 1 mm in lead V₄R. However, it is not possible to differentiate between occlusion of a distal right coronary artery and a circumflex artery using this criterion. In these patients (possible candidates for intracoronary thrombolytic therapy), coronary arteriography might start with the "wrong" coronary artery leading to a delay in reperfusion. Retrospectively, we have analyzed the configuration of the ST-T segment in lead V₄R to determine if changes in the ST-T segment can help predict the site of coronary occlusion in inferior wall AMI.

In patients admitted within 2 hours after the onset of chest pain and showing ST-segment elevation ≥ 1 mm in leads II, III and aVF, the lead V₄R was also recorded. Special attention was paid to the configuration of the ST-T segment. Three different shapes were distinguished (Figure 1): (1) ST-segment elevation ≥ 1 mm; (2) no ST-segment elevation but an ST segment with an upsloping shape; (3) no ST-segment elevation and a downsloping ST-T segment. This configuration was judged independently by 3 observers. Patients evaluated were younger than 75 years, had no history of previous coronary surgery, stroke or trauma, no enhanced risk of bleeding, no pregnancy and no bypass surgery of the vessel corresponding to the infarct location. When chest pain did not disappear after intravenous nitroglycerin had been administered in a dose that reduced systolic blood pressure to 100 to 120 mm Hg, 2 mg/min lidocaine, 5,000 U heparin, 250 mg acetylsalicylic acid and 100 mg prednisolone were given followed by 500,000 U streptokinase intravenously over 10 to 20 minutes. Thereafter, coronary angiography was performed using the Judkins technique. If the infarct-related artery was occluded,

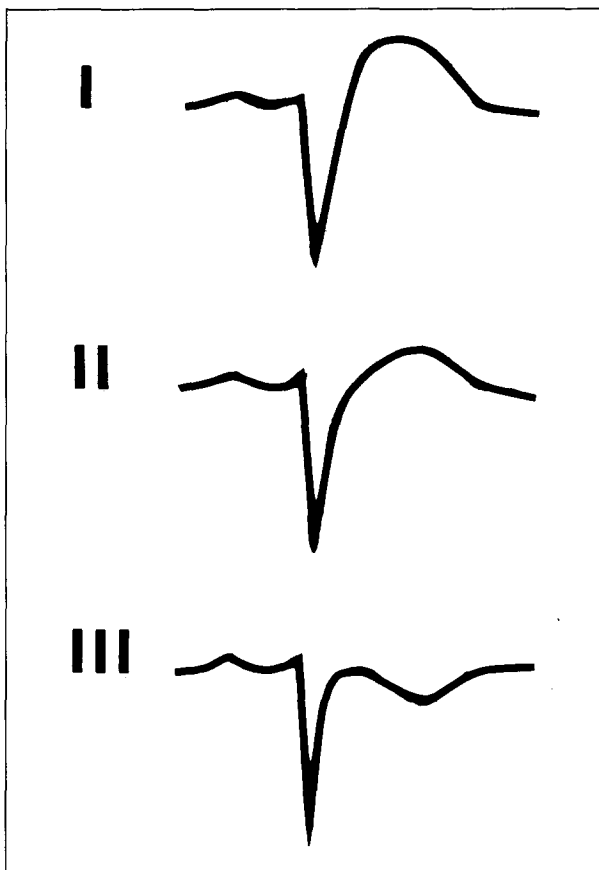


FIGURE 1. The 3 different shapes of lead V₄R in an acute inferior wall myocardial infarction. *I*, ST-segment elevation ≥ 1 mm. *II*, no ST-segment elevation but an ST segment with an upsloping shape. *III*, no ST-segment elevation with a downsloping ST-T segment.

intracoronary streptokinase was given at a rate of 4,000 U/liter until reperfusion or a maximum of 250,000 U/liter was reached. After completion of streptokinase infusion, complete right and left coronary arteriography was performed.

One hundred and seven patients (87 men, 20 women) fulfilled the inclusion criteria. Age ranged between 32 and 74 years (mean 57 ± 9).

The electrocardiograms were independently analyzed by 3 experienced electrocardiographers. ST-segment elevation in V₄R ≥ 1 mm was diagnosed by the 3 observers in 48, 45 and 48 patients, respectively. In 29, 32 and 32 patients, no ST-segment elevation with an upsloping ST-T segment in lead V₄R was diagnosed. In 30, 30 and 27 patients no ST-segment elevation with a downsloping ST-T segment was seen by the 3 different observers. In 28, 29 and 27 patients an ST-segment elevation ≥ 1 mm in aVL, V₅ or V₆ was seen.

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In 43 patients, an occluded or stenosed right coronary artery proximal to the first branch of the right ventricle was judged to be the cause of the AMI. In 31 patients, an occluded or stenosed right coronary artery distal to the first branch of the right ventricle and in 33 patients an occluded or stenosed circumflex artery were judged to be the cause of the ischemia.

ST-segment elevation in $V_4R \geq 1$ mm without a proximal lesion of the right coronary artery was seen in 9, 6 and 9 patients, respectively (Table I). In 4 patients, all 3 observers agreed about the absence of ST-segment elevation ≥ 1 mm in V_4R , although a proximal occluded right coronary artery was found on coronary angiography. In 7, 7 and 10 patients, an upsloping ST segment without elevation was seen without a lesion in the distal right coronary artery whereas in 9, 6 and 9 patients with a distal lesion in the right coronary artery no upsloping ST segment without elevation was diagnosed. No ST-segment elevation with a downsloping ST-T segment was seen by all 3 observers in 2 patients without a circumflex lesion. In 5, 5 and 8 patients, a circumflex artery lesion was found without a downsloping ST-T segment in lead V_4R . Thus, the different criteria used to detect the location of occlusion of the coronary artery had sensitivities, specificities and positive and negative predictive accuracies for the 3 observers as shown in Table II.

In the group of 28, 29 and 27 patients with ST-segment elevation >1 mm in aVL , V_5 or V_6 , 18 had a lesion in the circumflex coronary artery. Thus, the elevation of the ST segment in aVL , V_5 or V_6 has a sensitivity of 55%, a specificity of 86%, a positive predictive accuracy of 64% and a negative predictive accuracy of 81% in our patients.

TABLE I False Positive or Negative Correlation Between Electrocardiogram and Coronary Angiogram as Determined by Three Observers

	Observer 1	Observer 2	Observer 3
ST ≥ 1 mm without a proximal occluded right coronary artery (false positive)	9	6	9
No ST ≥ 1 mm with a proximal occluded right coronary artery (false negative)	4	4	4
Upsloping ST-T segment without elevation ≥ 1 mm and no distal RCA occlusion (false positive)	7	7	10
No upsloping ST-T segment and no elevation ≥ 1 mm with a distal RCA occlusion (false negative)	9	6	9
Downsloping ST-T segment without elevation in V_4R and no circumflex artery occlusion (false positive)	2	2	2
No downsloping ST-T segment without elevation and a circumflex artery occlusion (false negative)	5	5	8
RCA = right coronary artery.			

TABLE II Sensitivity, Specificity and Accuracy

ST-Segment Elevation in $V_4R \geq 1$ mm Predicts a Proximal Occlusion in the Right Coronary Artery				
	Observer 1	Observer 2	Observer 3	Consensus
Sensitivity (%)	91	90	91	93
Specificity (%)	86	91	86	88
Positive predictive accuracy (%)	81	86	81	83
Negative predictive accuracy (%)	93	94	93	95
No ST-Segment Elevation with an Upsloping ST-T Segment Predicts a Distal Occluded Right Coronary Artery				
	Observer 1	Observer 2	Observer 3	Consensus
Sensitivity (%)	90	80	74	74
Specificity (%)	91	91	86	92
Positive predictive accuracy (%)	76	77	70	73
Negative predictive accuracy (%)	88	92	89	90
No ST-Segment Elevation and a Downsloping ST-T Segment Predicts a Circumflex Artery Occlusion				
	Observer 1	Observer 2	Observer 3	Consensus
Sensitivity (%)	85	86	76	85
Specificity (%)	97	97	97	97
Positive predictive accuracy (%)	93	94	93	93
Negative predictive accuracy (%)	94	93	90	94

The 3 observers had judged the location in the coronary artery incorrectly in 28 of 107 patients. In 10 patients, the same incorrect diagnosis was made by 2 observers and in 12 patients an incorrect diagnosis was made by 1 observer. In 6 patients all 3 observers made an incorrect diagnosis.

An incorrect diagnosis was made in 16 patients when the electrocardiograms were reviewed together. In 8 patients, an ST-segment elevation ≥ 1 mm was judged to be present without a proximal stenosis in the right coronary artery. In 6 patients, an upsloping ST-T segment without ST-segment elevation in V_4R was diagnosed without a distal lesion of the right coronary artery and in 2 patients a downsloping ST-T segment with no elevation and no lesion of the circumflex artery was diagnosed (for sensitivity, specificity and predictive accuracy of decisions made by consensus, see Table II).

The results of thrombolytic therapy in AMI show a relation with the delay between onset of complaints and start of administration of the thrombolytic agents. The shorter the delay was, the better the results were. In patients with an inferior wall AMI the infarct-related coronary artery can be the right coronary artery or the circumflex coronary artery. Thus, in those patients undergoing intracoronary thrombolytic therapy it would be helpful to know which coronary artery is related to the AMI to prevent the delay caused by starting with the "wrong" coronary artery.

In our retrospective study, 3 observers predicted the site of occlusion in the coronary artery with good sensitivity, specificity and predictive accuracy. Differences between the 3 observers were minimal. Incorrect determination of the obstruction site in the coronary artery

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by electrocardiographic criteria of lead V₄R was done in 6 patients by all 3 observers, in 10 patients by 2 observers and in 12 patients by 1 observer. These findings suggest in some patients absence of correlation between electrocardiographic and coronary angiographic findings rather than intraobserver variability. Using the criteria of ST-segment elevation ≥ 1 mm in aVL, V₅ or V₆ in the admission 12-lead electrocardiogram, we found only a sensitivity of 55% and a specificity of 86%. These numbers are not in agreement with those of Bairey et al,⁷ a possible explanation being their smaller group of patients.

The configuration of the ST-T segment in lead V₄R was shown in our study to be a sensitive and specific tool to recognize the occluded vessel. Since it is an inexpensive method that can be readily used in every hospital, we advise recordings with lead V₄R to be performed in all patients admitted with an inferior wall AMI.

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Isolated Obstruction of Large Septal Perforators

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Obstruction of large septal perforators in patients with diffuse coronary artery disease is common. Obstruction of septal perforators in the absence of significant narrowing in other branches, however, has only been reported once.¹ Since 1977, we have encountered 4 such cases and in all of them this condition had led to significant septal ischemia. This study presents specific clinical findings and discusses diagnostic and therapeutic implications.

The clinical and angiographic data of the 4 patients are presented in Table 1. Three patients were referred because of angina and 1 for surgical closure of the ventricular septal defect that had occurred during the acute phase of an anteroseptal myocardial infarction 2 months earlier. Exercise tests and thallium-201 scintigraphy at rest and during exercise could only be performed in 2 patients. One had an exercise test with normal results and a persistent perfusion defect in the proximal septum, while the other patient had both a positive result in the exercise test and a stress-related perfusion defect in the proximal septum. Angiography of the left ventricle showed abnormal systolic septal motion in all patients. Coronary angioplasty revealed severe septal perforator stenosis or occlusion with collateral filling and otherwise normal coronary arteries in all patients. The ventricular septal defect to be surgically closed was seen oblong to the course of a septal perforator, measured 1.5×1.0 cm² and was surrounded by fibrous scar tissue. Microscopy

of a scar tissue biopsy confirmed the diagnosis of old myocardial infarction.

Usually the ventricular septum receives more than two-thirds of its blood supply by septal perforators originating from the left anterior descending artery. Occasionally, proximal septal perforators originate from diagonal

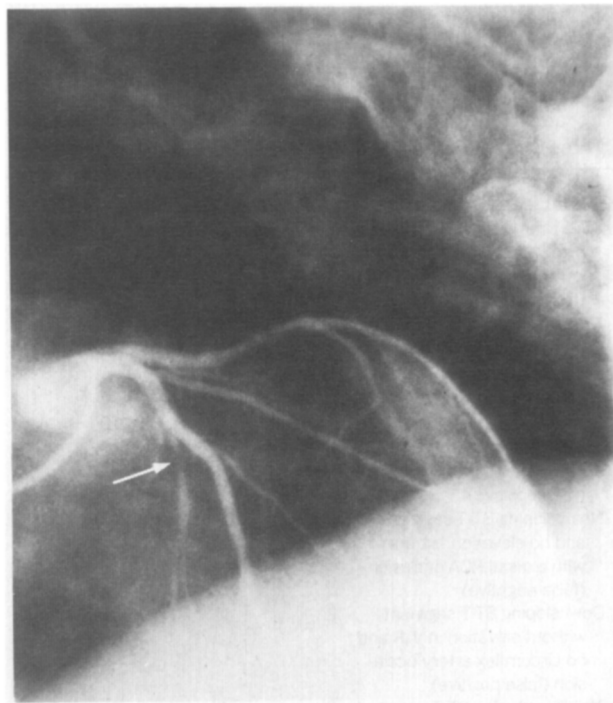


FIGURE 1. Contrast injection in the left coronary artery of patient 2 (left anterior oblique projection, craniocaudal tilt). An isolated severe stenosis in the first septal perforator is noted (arrow).

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