
CLINICAL SIGNIFICANCE OF EXERCISE INDUCED "ST SEGMENT" ELEVATION AFTER MYOCARDIAL INFARCTION: A MYOCARDIAL PERFUSION SCINTIGRAPHY COMPARISON WITH CORONARY ANGIOGRAPHY STUDY

İ. DİNDAR M.D.,
N. KURTOĞLU, M.D.,
O. DEMİRKOL, M.D.,
F. TURAN, M.D.

From: Koşuyolu Heart
and Research Hospital,
Koşuyolu, İstanbul,
Türkiye

**Adress for
reprints:**

İ. DİNDAR, M.D.,
Koşuyolu Heart and
Research Hospital,
Koşuyolu
81020 İSTANBUL,
TÜRKİYE

After myocardial infarction (MI), ST segment elevation during exercise testing in infarct related leads can be interpreted as left ventricular dyskinesia. Nevertheless, some studies indicate residual viable tissue in infarct zone. Because this phenomena is not completely understood, this study was planned. We investigated the relation between ST segment elevation and viable tissue in infarct zone; coronary artery perfusion scoring, left ventricle segment scoring; and collateral perfusion.

Forty-five patients with previous myocardial infarction were admitted to the study. Nine patients had thrombolytic therapy. Exercise testing with Bruce protocol, and Tl-201 stress reinjection (SPECT) myocardial perfusion scintigraphy (MPS) were performed in all of the patients. We accepted ST segment elevation at least 1 mm in infarct related leads meaningful (mean 1.8 ± 0.7 mm). Selective coronary angiography and left ventriculography were performed with Judkins technique. Left ventricle segment scoring, coronary perfusion scoring, and colleteral scoring were done. While ST segment elevation were seen in 24 patients (53.3%)(group I), ST segment elevation was not seen 21 patients (46.7%)(group II). The time interval between MI and MPS was 130 ± 35 days in group I, and 413 ± 129 days in group II ($p < 0.05$). Previous myocardial infarctions and its locations were approved with MPS. Reversible perfusion defect occurred in 21 patients: (83.3%) in group I, and 7 patients (33.4%) in group II ($p < 0.001$). Left ventricle segment

score was 3.9 ± 2.03 in group I and 3.3 ± 2.08 in group II ($p > 0.05$). Infarct related artery perfusion score also was not different between the two groups; (32.35 ± 5.73 vs 26.21 ± 3.61) ($p > 0.05$). Total occlusion of the infarct related artery was seen in 15 patients in group I, and in 3 patients in group II. Grade 2-3 collateral perfusion according to TIMI classification were seen 7 patients (46.6%) in group I, and in 3 patients (30%) in group II ($p > 0.05$). There were 20 anterior and 4 inferior myocardial infarction in group I, and 10 anterior and 11 inferior myocardial infarction in group II ($p < 0.05$). In conclusion; ST segment elevation in infarct related leads after myocardial infarction, especially in the early period could be a sign of residual viable tissue. MPS TI-201 reinjection especially could be a valuable study in this patient group.

Key words: Myocardial infarction, ST segment elevation, perfusion myocardial scintigraphy

The importance of ST segment elevation in exercise testing after previous myocardial infarction has not been determined. In general, residual viable tissue in infarct zone¹⁻³, or dyskinetic motion of the infarct area⁴⁻⁷ may be responsible of ST segment elevation. Reperfusion of the residual viable tissue with revascularization procedures can improve function and prognosis. The aim of this study, was to determine exercise ST segment elevation in infarct related leads after myocardial infarction.

MATERIAL AND METHOD

We studied 45 patients who were diagnosed myocardial infarction with clinical examination, serial electrocardiographic recordings, and serum enzyme determinations at the Koşuyolu Heart and Research Hospital coronary care unit. There were 42 men (93.4%) and 3 women (6.6%) (mean age 52.3 ± 8.3).

Exercise test.

Patients performed a maximal, symptom-limited exercise testing with Bruce protocol after antianginal therapy had been withdrawn for 3 days. The 12-lead electrocardiogram and blood pressure were recorded at 1 minute intervals during the exercise testing. Exercise was terminated for the occurrence of any of the following: achievement of the maximal predicted heart rate, severe angina, complex ventricular arrhythmia, physical exhaustion, and ≥ 1 mm ST segment depression in non-infarct related leads. ST segment elevation in infarct related leads were not considered a reason for exercise termination.

Perfusion scintigraphy.

After injection of $74\text{-}111$ MBq (2-3 mCi) TI-201 at peak exercise, the test was discontinued 1 minutes later. Tomographic images were obtained in transvers plane 5 minutes after the exercise termination. Immediately after first period, 37-55 MBq TI-201 was injected. Images were obtained with a large field view of gamma camera (Sophy Camera-France) equipped with a low energy, general purpose collimator. Tomographic images were reconstructed with Hamming/Hann filter which used back projection method. Scintigrams were evaluated in oblique-transvers, saggital and coronal planes independently.

Cardiac Catheterization.

Selective coronary angiography and left ventriculography were performed with the Judkins technique to all patients. 30° right anterior oblique, and 60° left anterior oblique views were used for left ventriculography. On the basis of American Heart Association recommendations,⁸ left ventricle silhouette was divided into seven segments and regional wall motion was scored in each as following: grade 0: normal, grade 1: hypokinesia, grade 2: akinesia, grade 3: dyskinesia. Global left ventricle score was obtained by adding single segment scores.

The left and right coronary arteries were imaged in multible views. Infarct related artery perfusion score was obtained by The Gensini method⁹. Subtotally and totally

occluded vessels were graded for collateral perfusion. TIMI classification¹⁰ was used for collateral perfusion of infarct related artery.

Statistics.

All values were expressed as mean values \pm of standard deviation. Significance of continuous variables was evaluated by a two tailed student t test. Parametric variables were compared by chi square and Fischer tests.

RESULTS

Clinical characteristics.

While 24 of 45 patients (53.3%) had exercise induced ST segment elevation, 21 patients (46.7%) did not show any ST segment elevation. There were 22 men (91.7%) and 2 women (9.3%) in group I, and 20 men (95%) and 1 woman (5%) in group II (mean age 51.9 ± 8.9 yrs vs 52.8 ± 7.8 yrs). There were 20 anterior (93.3%) and 4 inferior (16.7%) myocardial infarction in group I, and 10 anterior (47.6%) and 11 inferior (52.4%) myocardial infarction in group II ($p < 0.05$). The time interval between myocardial infarction and myocardial perfusion scintigraphy was 130 ± 35 days in group I, and

413 ± 129 days in group II ($p < 0.05$). 7 patients had thrombolytic therapy in group I, and 2 patients in group II.

Coronary angiography and left ventriculography.

Fourteen patients had one-vessel, 4 patients had two-vessel, and 4 patients had three-vessel disease in group I; while 5 patients had one-vessel, 10 patients had two-vessel, and 5 patients had three-vessel disease in group II. We evaluated coronary angiography as normal in 2 patients in group I, and in 1 patient in group II. There was no significance in infarct related artery perfusion score between two groups (35.6 ± 29.1 vs 24.3 ± 19.5) ($p > 0.05$). Total occlusion of the infarct related artery was present in 15 patients in group I, and in 10 patients in group II. Grade 2-3 collateral perfusion according to TIMI classification were seen 7 patients (46.6%) in group I, and in 3 patients (30%) in group II ($p > 0.05$). Left ventricle segment score was 3.95 ± 2.03 in group I, and 3.33 ± 2.08 in group II ($p > 0.05$).

Exercise testing.

Exercise was terminated because of angina in 2 patients in group I. Exercise duration was 570 ± 194 second in group I and 595 ± 180

Table 1. Comparison of groups.

	ST segment positive Group I	ST segment negative Group II	p value
Patient (n/%)	24 / 53.3	21 / 46.7	
Gender (M / F)	22 / 2	20 / 1	
(%)	91.7 / 9.3	95 / 5	
Age	51.9 ± 8.9	52.8 ± 7.8	NS
AMI's age	130 ± 35 day	413 ± 129	$p < 0.05$
Anterior / Inferior MI	20 / 4	10 / 11	$p < 0.05$
Infarct related artery perfusion scoring	35.6 ± 29.1	24.3 ± 19.5	NS
Collateral perfusion	7 (46.6%)	3 (30%)	NS
Left ventricle segment score	3.95 ± 2.03	3.33 ± 2.08	NS
Exercise duration (s)	570 ± 194	595 ± 180	NS
Double product (beat mm-Hg/min)	20.5 ± 4.5	21.7 ± 3.7	NS
Viable tissue evidence	20 (83.3%)	7 (33.4%)	$p < 0.001$

NS: non significant. AMI's age: Interval from previous myocardial infarction to perfusion scintigraphy.

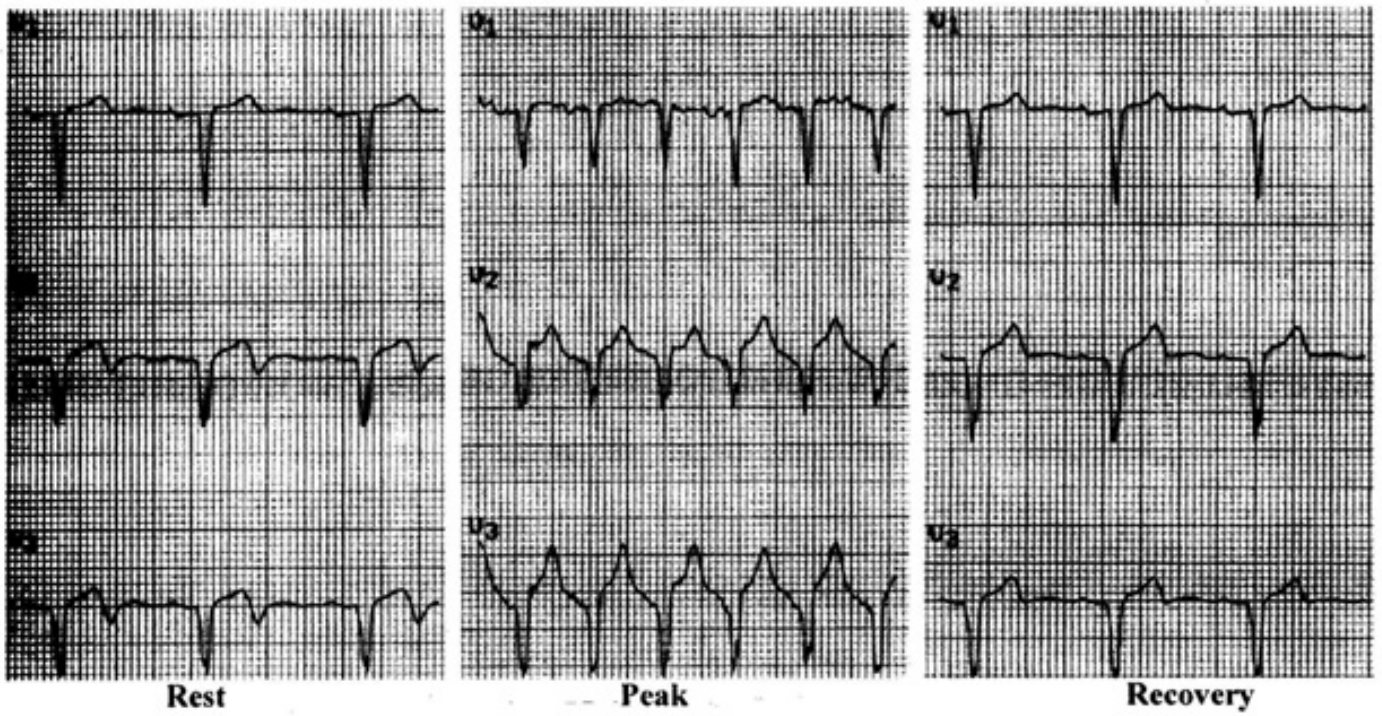


Figure I. Exercise testing shows "ST segment" elevation in infarct related leads.

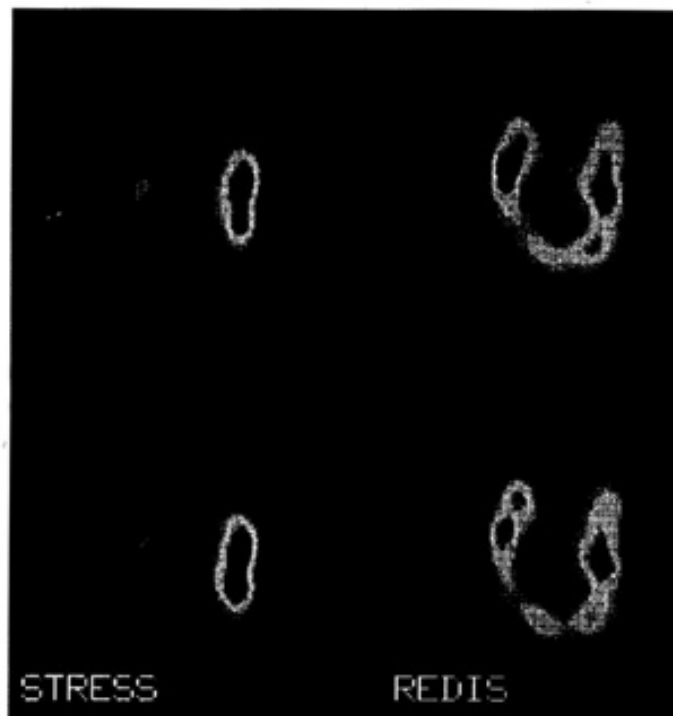


Figure 2. Reversible perfusion defect shows viable infarct tissue in infarct zone.

second in group II ($p>0.05$). At peak exercise double-product was 20.5 ± 4.5 beats mmHg/min in group I and 21.7 ± 3.7 beats mmHg/min in group II ($p>0.05$).

Perfusion scintigraphy.

A fixed perfusion defect, consistent with the site of previous myocardial infarction was seen in all patients. There were 20(83.3%) patients with reversible perfusion defect in group I and 7 patients (33.4%) in group II ($p<0.001$). There was no statistical significance between previous thrombolytic therapy, and evidence of residual viable tissue (9/6, 66.6% vs 36/20, 55.5%) ($p>0.05$).

DISCUSSION

ST segment elevation in infarct related leads after myocardial infarction is not encountered rarely. Previous studies indicated that left ventricular dyskinesia or viable tissue in infarct zone might be responsible for this finding. In our study, ST segment elevation in infarct related leads was associated (83.3%) with a reversible perfusion defect on myocardial perfusion scintigraphy. In addition, patients with previous anterior infarction had ST segment elevation more frequent than inferior infarction on exercise testing. Compared with previous studies; Dunn et al². found reversible ischemia on thallium 201 scans in 52%, and Margonato et al¹. found 94%. In Dunn's study antianginal treatment wasn't withdrawn before the exercise testing. So this may be explanation of discrepancy between ours and Dunn's studies. Margonato found higher ratios of reversible perfusion defect because their patients had higher collateral perfusion. Another important point was, perfusion scintigraphy was done in a shorter period (>5 months) following myocardial infarction in the ST segment elevation group. This was concordant with Fragasso's study by positron emission tomography. In this study it was stated that persistence of metabolically active tissue is frequent in the first months after myocardial infarction, and that the presence of viable myocardium decreases thereafter. Margonato stated that, patients who had thrombolytic

therapy within 4 hours of myocardial infarction had higher ratios of residual viable tissue. Ineffective thrombolysis might be the reason that we could not achieve the same results. At least 98% or higher coronary lesions were taken seriously for collateral grading and we couldn't find any relation between residual viable tissue and collateral grading. But, at least some infarct related artery shouldn't be completely occluded, and should perfuse the infarct area by itself. So, it mustn't be wrong that patients who have better antegrade perfusion, have higher ratio of reversible viable tissue on myocardial perfusion scintigraphy.

CONCLUSION

In our opinion, ST segment elevation in exercise testing in infarct related leads after shorter periods of myocardial infarction indicate the residual viable tissue in infarct zone. MPS TI-201 reinjection especially could be performed in this patient group. This result can help to determine the patients potentially benefiting from revascularization procedures.

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