Importance of Reciprocal ST Segment Depression in the Extensive Coronary Artery Disease

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ABSTRACT

Aim: *We investigated the relationship between the severity of reciprocal ST depression and the extent of coronary artery disease in patients with inferior myocardial infarction.*

Method: *Ninety-five consecutive patients (52 women 43 men, with a mean age of 54±5 years) who had acute inferior myocardial infarction were included in the study. Reciprocal changes in the ST segment were defined as ST depression of >1 mm in at least two out of four of the precordial leads V1-V4. All the patients had undergone coronary angiography within seven days of admission. The extension of coronary artery disease which was measured by Gensini and Reardon scores, was compared with the reciprocal changes on ECG recorded at the time of admission.*

Result: *There was a significant correlation between reciprocal ST depression and disease extension (r=0.68 for Gensini score, r= 0.88 for Reardon score, p<0.05 for both).*

Conclusion: *The presence of ST segment depression in the precordial leads during the acute inferior myocardial infarction was associated with greater myocardial necrosis and more frequent left coronary artery disease.*

Key words: *Coronary artery disease, acute myocardial infarction, and Reciprocal ST segment depression*

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INTRODUCTION

Over the past 2 decades, the 12-lead electrocardiogram (ECG) has attained special significance for the diagnosis and triage of patients with chest pain because timely detection of myocardial injury and a rapid assessment of myocardium at risk proved pivotal to implementing effective reperfusion therapies during acute myocardial infarction (1). Henry Marriott wrote that the electrocardiogram is "the single most often used, most cost-effective, and most diagnostic test in cardiology" and also "the most frequently misinterpreted" (2). The ECG changes were and still are considered as a primary reflection of the injured myocardial zone. Reciprocal ST segment depression (RSTD) is a well known ECG sign often accompanying ST segment elevation myocardial infarction (STEMI). The ST depression is captured by a lead placed at 180 degrees of the lead recording the ST elevation, although the terms "reciprocal" and "mirror" are loosely applied to recording points in the complementary electrocardiographic spatial plane as well (11). Its significance and prognostic value have been the subject of many reports. Anterior RSTD accompanying acute inferior myocardial infarction was shown to be attributable to the co-existent left anterior descending artery (LAD) disease (4,5), lower left ventricular ejection fraction (LVEF) (6,7) and poor prognosis. However conflicting results were also reported (8,9). This study was conducted to investigate the relationship between the severity of RSTD and the extent of coronary artery disease.

MATERIAL AND METHODS

Ninety-five consecutive patients (52 women 43 men, with a mean age of 54±5 years) who had acute inferior myocardial infarction with RSTD were included in the study. Acute inferior wall MI was diagnosed by: typical chest pain at least 30 minutes, ST-segment elevation of more than 0.1 mV in at least two leads representing the inferior wall (DII, DIII, AVF), and an increase in cardiac enzymes to more than twice of normal (5 IU/L for creatine kinase MB isoenzyme). The presence of right ventricular infarction was defined by an ST segment elevation ≥0.1 mV in lead V4R. R wave to S wave ratio>1 in V1and V2 was defined as posterior MI. Reciprocal changes in the ST segment were defined as ST depression of >1 mm in at least two out of four of the precordial leads V1–V4.

Exclusion criteria were previous MI, previous revascularization, associated posterior or right ventricular MI, intraventricular conduction disturbances, valvular heart disease, hypertrophic, dilated, or restrictive cardiomyopathies, and significant arrhythmias including atrial fibrillation, supra ventricular or ventricular tachycardia, and ventricular bigeminy. A standard 12-lead ECG was recorded immediately after arrival at the coronary care unit. Reciprocal changes in the ST segment were defined as ST depression of >1 mm in at least two out of four of the precordial leads V1–V4 in patients with inferior infarction. All the patients had undergone coronary angiography within seven days of admission. Coronary angiography was performed by the femoral approach with 6 French diagnostic catheters. Images were recorded in multiple projections for left and right coronary arteries on a digital system. Two cardiologists who were blinded for the characteristics of the patients during the interpretation made the interpretation of the coronary angiograms.

The extension of coronary artery disease was measured by Gensini (12) and Reardon (13) scores. Gensini score which grades narrowing of the lumens of the coronary arteries as 1 point for 1-25% narrowing, 2 for 26-50% narrowing, 4 for 51-75% narrowing, 8 for 76-90% narrowing, 16 for 91-99% narrowing, and 32 for total occlusion (12). This score is then multiplied by a factor that takes into account the importance of the lesion's position in the coronary arterial tree, for example, 5 for the left main coronary artery, 2.5 for the proximal left anterior descending coronary artery and proximal left circumflex coronary artery (3.5 if left circumflex coronary artery is dominant), 1.5 for the mid-region of the left anterior descending coronary artery, 1 for the distal left anterior descending coronary artery, the first diagonal, the proximal, mid and distal-region of the right coronary artery, the postero-descending, the mid- and distal-region of the left circumflex coronary artery (2 for both of them if left circumflex coronary artery is dominant) and the obtuse margin, and 0.5 for the second diagonal and the postero-lateral branch. The Gensini score was expressed as the sum of the scores for the all coronary arteries. In Reardon score system we divided coronary arteries to four parts (Left main, Left anterior descending, right coronary, circumflex artery). Each part divided to segments. Atherosclerotic lesion of each segments was scored (Normal: 0 point, <50%:1 point, 50-74%:2 point, 75-99%:3 point, 100%:4 point). Total scores were calculated by sum of each segments score (13). ECG measurements were performed as previously described by a single reader who was blinded to the angiographic findings and clinical findings, by use of electronic calipers (14).

Table 1: Patient Characteristics of the study group

Age (years)	*54±5*
Men	*43 (45.26 %)*
Systemic hypertension	*17 (18 %)*
Cigarette smoking	*27 (28 %)*
Diabetes mellitus	*24 (25%)*
Systolic blood pressure (mmHg)	*121±40*
Diastolic blood pressure (mmHg)	*72±22*

The amount of ST segment depression at 0.08 second after the J point in the reciprocal leads on admission 12-lead electrocardiograms of the patients were also evaluated for the quantification of RSTD (mm). The correlation between the RSTD and angiography scores was investigated. Informed consents were obtained from patients and local ethic committee approved the study protocol.

Statistical Analysis

Parametric variables presented as a mean± standard deviation, nonparametric variables presented as a frequency and percent. Spearman's rho test was used for correlation analysis. $p < 0.05$ was considered significant.

RESULTS

The clinical and demographic features of the patient population are presented in Table 1. Ninety-five patients who underwent detailed electrocardiographic coding were included in the analysis comprising 43 (45.26%) men and 52 (54.74%) women.

Mean age of the cohort was 54.3±5 years. 17 patients (18%) had hypertension, 24 (25%) had diabetes mellitus and 27 patients (28%) was smoker. The mean values of RSTD , Gensini and Reardon scores were found to be 3.73±2.75 mm, 31.2±30.2 and 7.25±3.54, respectively. There was also a significant positive linear correlation between the RSTD and angiography scores ($r=0.68$ for Gensini, $r= 0.88$ for Reardon, $p<0.05$ for both). Men and women did not differ significantly with regard to these parameters and correlations.

DISCUSSION

The significance of reciprocal ST segment depression on the electrocardiogram during the early stages of myocardial infarction has interested many researchers and has been the subject of many debates regarding its mechanism. Opinion is divided as to whether it is a sign of multivessel coronary disease and an adverse prognosis (5), or a benign electrical phenomenon (4-6). The significance of anterior ST depression accompanying inferior transmural injury, on the other hand, may depend on the leads involved. ST depression in leads V1 through V3 or DI to AVL appears to correspond to mere mirroring, often from circumflex artery occlusion (15). Lee et al. found a 1-year mortality rate of 31% in a cohort of patients who were seen in 1990 with ST-segment depression in whom AMI was confirmed (16). In a study of more than 1000 patients with inferior infarction, the presence of maximum ST depression in leads V1 through V3 indicated a much lower probability of proximal right coronary artery occlusion than its absence or than a maximum ST depression in leads V4 through V6. On the other hand, a maximum ST depression in leads V4 through V6 is associated with septal asynergy and most likely corresponds to anterolateral or septal subendocardial injury from a severe lesion in the left anterior descending artery or in the left main coronary artery, or it is associated with triple-vessel disease (17). Gibelin B et al. found that the persistence of ST segment depression for more than 48 hours was associated with a more severe depression of the ejection fraction than transient depression (less than 48 hours). The fact that patients with ST depression in leads V1 through V3 often have a greater magnitude of ST elevation in inferior leads than patients with ST depression in leads V4 through V6 may be due to a "canceling effect" from the concomitant left anterior descending artery lesion in the latter group. Billadello et al. used positron tomography to show that 67% of patients with reciprocal ST depression did not have anterior wall metabolic abnormalities during acute inferior wall infarction (18). Crawford et al. used an animal model to demonstrate that inferior ST segment depression represents a reciprocal ECG change (19). The left anterior descending artery was ligated in 13 baboons, and all had inferior lead ST depression. Further evidence supporting a reciprocal phenomenon was provided by studies of controlled coronary occlusion during angioplasty, in which reciprocal change is no more common in patients with multivessel disease than in those with single vessel disease (20). Our data demonstrated a significant positive linear correlation between the RSTD and angiography scores (Gensini-Reardon) indicating severe RSTD as a marker of extensive coronary artery disease.

Limitations of the study: The study lacks a control group. Comparison with a control group without reciprocal depressions would yield more accurate results.

In conclusion, the presence of ST segment depression in the precordial leads during the acute phase of inferior myocardial infarction was associated with greater myocardial necrosis and more frequent left coronary artery disease, thus identifying a subset of high risk patients.

REFERENCES

1. *Willems JL, Amaud P, van Bemmel JH, et al. Assessment of the performance of electrocardiographic computer programs with the use of a reference database. Circulation 1985;7:523-34.*
2. *Sgarbossa EB, Wagner GS. Electrocardiography. In: Topol EJ, editor. Textbook of cardiovascular medicine. Philadelphia (Pa): Lippincott-Raven Publishers; 1997 p.1545-89.*
3. *Sharkey SW, Berger CR, Brunette DD, et al. Impact of the electrocardiogram on the delivery of thrombolytic therapy for acute myocardial infarction. Am J Cardiol 1994;73:550-3.*
4. *Mirvis DM. Physiologic bases for anterior ST segment depression in patients with acute inferior wall myocardial infarction. Am Heart J 1988;116:1308-22.*
5. *Little WC, Rogers EW, Sodiums MT. Mechanism of anterior ST segment depression during acute inferior myocardial infarction. Ann Intern Med 1984;100:226-9.*
6. *Wasserman AG, Ross AM, Bogaty D, et al. Anterior ST segment depression during acute inferior myocardial infarction: Evidence for the reciprocal change theory. Am Heart J 1983;105:516-20.*
7. *Shah PK, Pichler M, Berman DS, et al. Non-invasive identification of a high risk subset of patients with acute inferior myocardial infarction. Am J Cardiol 1980;46:915-21.*
8. *Camara EJN, Chandra N, Ouyang P, et al. Reciprocal ST change in acute myocardial infarction: Assessment by electrocardiography and echocardiography. J Am Coll Cardiol 1983;2:251-7.*
9. *Pichler M, Shah PK, Peter T, et al. Wall motion abnormalities and electrocardiographic changes in acute transmural myocardial infarction: Implications of reciprocal ST segment depression. Am Heart J 1983;106:1003-13.*
10. *Dewhurst NG, Muir AL. Clinical significance of "reciprocal" ST segment depression in acute myocardial infarction. Am J Med 1985;78:765-70.*
11. *Camara EJN, Chandra N, Ouyang P, et al. Reciprocal ST change in acute myocardial infarction: assessment by electrocardiography and echocardiography. J Am Coll Cardiol 1983;2:251-7.*
12. *Gensini GG. A more meaningful scoring system for determining the severity of coronary heart disease. Am J Cardiol 1983;51(3):606.*
13. *Reardon MF, Nestel PJ, Craig IH et al. Lipoprotein predictors of the severity of coronary artery disease in men and women. Circulation 1985;71(5):881-8.*
14. *de Lemos JA, Antman EM, Giugliano RP, et al. ST-segment resolution and infarct-related artery patency and flow after thrombolytic therapy. Thrombolysis In Myocardial Infarction (TIMI) 14 investigators. Am J Cardiol 2000;85:299-304.*
15. *Tamura A, Kataoka H, Mikuriya Y, et al. Inferior ST-segment depression as a useful marker for identifying proximal left anterior descending coronary artery occlusion during acute myocardial infarction. Eur Heart J 1995;16:1795-9.*
16. *Lee HS, Cross SJ, Rawles JM, et al. Patients with suspected myocardial infarction who present with ST depression. Lancet 1993;342:1204-7.*
17. *Ben-Gal T, Sclarovsky S, Herz I, et al. Importance of the conal branch of the right coronary artery in patients with acute anterior wall myocardial infarction: electrocardiographic and angiographic correlation. J Am Coll Cardiol 1997;29:506-11.*
18. *Billadello JJ et al. Implication of reciprocal ST segment depression associated with acute myocardial infarction identified by positron tomography. J Am Coll Cardiol 1983; 2:251-7.*
19. *Crawford MH et al. Mechanism of inferior electrocardiographic ST segment depression during acute anterior myocardial infarction in a baboon model. Am J Cardiol 1984;54:1114-7.*
20. *Quyyimi AA et al. Importance of "reciprocal" electrocardioghraphic changes during occlusion of left anterior descending coronary. Lancet 1986;1:347-50.*