ST Segment Depression in Right-Sided Electrocardiographic Leads in Patients With Acute Myocardial Infarction*

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The presence of ST segment depression in right-sided electrocardiographic leads has been infrequently reported in the literature. We report the cases of two patients with anterolateral and posterior myocardial infarctions with ST segment depression in right-sided electrocardiographic leads. We hypothesize that this electrocardiographic change is a reciprocal expression of ST segment elevation of the opposing left ventricular wall.

CASE REPORTS

CASE 1

The patient, a 67-year-old white woman, was transferred to our institution with approximately 6 h of substernal chest discomfort. Her admission ECG (Fig 1) was significant for a prominent R wave in leads V1, and V6, with anteroseptal ST segment depression and lateral ST elevation consistent with a posterior myocardial infarction with lateral wall involvement. A right-sided ECG (Fig 2) was performed to evaluate persistent hypotension and revealed ST segment depression in leads V4, through V6.

Creatinine phosphokinase levels peaked at 3,000 with 10 percent MB fraction. An echocardiogram revealed left ventricular hypertrophy with severe inferior hypokinesis and posterolateral akinesis with the appearance of a posterior aneurysm. The right ventricular free wall appeared to contract normally. Cardiac catheterization revealed akinesis of the posterolateral and inferior walls and hypokinesis of the inferobasal wall. Left ventricular ejection fraction was reduced at 35 percent. Coronary angiography revealed a proximal 70 percent lesion in the left anterior descending artery, a proximally occluded left circumflex coronary artery, and a 90 percent distal stenosis of the right coronary artery. Follow-up right-sided ECGs on days 2 and 3 demonstrated persistent ST segment depression in leads V4, and V6.

CASE 2

A 65-year-old woman was referred to our institution with severe substernal chest discomfort. An ECG revealed ST segment elevation in the anterior precordial leads consistent with acute anterolateral myocardial infarction (Fig 3). The patient received thrombolytic therapy (tissue type plasminogen activator) and was referred to our hospital.

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Figure 1. Admission electrocardiogram of patient 1 with prominent R waves and ST depression in anteroseptal leads and lateral ST segment elevation consistent with acute posterolateral infarction.

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ST Segment Depression in Acute MI (Bradley, Gore)
Right-sided ECG leads at the time of transfer revealed ST segment depression in lead V₆₄ (Fig 4) coincident with anterolateral ST segment elevations in the standard precordial leads. Creatinine phosphokinase levels peaked at 2,083 with 11 percent MB fraction. An echocardiogram on the first day of hospitalization revealed anterolateral wall hypokinesis. The right ventricular free wall appeared to contract normally. The ST segment depression in the right precordial leads was transient and became isoelectric in lead V₆₃ 3 h postinfarction with preservation of a small R wave. This was coincident with clinical evidence of reperfusion after thrombolytic therapy with relief of chest discomfort and resolution of anterolateral ST elevation in the standard precordial electrocardiographic leads.

Cardiac catheterization was subsequently performed and revealed anterolateral wall akinesia with an ejection fraction of 42 percent. The left anterior descending coronary artery had an 80 percent proximal stenosis before the first diagonal branch. The left circumflex coronary artery and the right coronary artery had irregularities without significant stenosis.

**FIGURE 2.** Admission electrocardiogram of patient 1 demonstrating ST segment depression in right-sided leads.

**FIGURE 3.** Admission electrocardiogram of patient 2 with anterolateral ST elevation consistent with acute anterolateral infarction.

**FIGURE 4.** Admission electrocardiogram of patient 2 revealing ST segment depression in right-sided leads.

**DISCUSSION**

The value of ST segment elevation in the right-sided ECG leads in the diagnosis and early recognition of right ventricular infarction has been reported by a number of investigators. However, ST segment depression in right-sided ECG leads has been infrequently reported and the clinical significance not discussed.

Anderson et al recorded right-sided chest leads (V₃R-V₇R) in 109 patients without evidence of heart disease and found 1 percent and 4 percent to have a QS configuration in leads V₃R and V₇R, respectively. Ninety-five percent of their patients had ST segment deviation in V₇R 40 ms after the last QRS deflection of 0.4 to 0.5 mm with a range of −1.4 to +0.6 mm. Tan et al recorded right-sided ECG leads from 110 patients and found 1 percent had ST segment depression in leads V₇R and V₃R with a mean deviation of −0.8 mm and a range of −0.5 to −1.0 mm. This study suggests that right-sided ECG leads may be useful in the diagnosis and early recognition of right ventricular infarction.
normal male patients and found a 1.0 percent incidence of a QR and QS pattern in $V_{4R}$.\textsuperscript{15} Five percent of their patients had positive ST deviations of 0.5 to 1.0 mm, 80 ms after the last QRS complex. None of their patients had more than 1.0 mm of positive ST segment deviation. Negative ST segment deviation was not commented upon. Braat et al\textsuperscript{16} studied 107 patients with coronary artery disease with exercise testing and found 4 of the 107 patients to have greater than 1.0 mm of ST depression in lead $V_{4R}$ with exercise. The significance of ST depression in this subgroup was not specifically commented upon.

Kreuger et al\textsuperscript{17} recently evaluated right-sided electrocardiographic leads during angioplasty and found greater than 1.0 mm of ST segment depression in lead $V_{4R}$ in 9 of 75 angioplasties involving the left anterior descending coronary artery, 13 of 39 angioplasties of the left circumflex coronary artery, and none of 50 angioplasties of the right coronary artery. The ST segment depression was felt to represent reciprocal changes from the anterior and posterior walls of the left ventricle, respectively. Right ventricular ischemia during 34 angioplasties of the proximal right coronary artery resulted only in ST segment elevation in lead $V_{4R}$ without episodes of ST depression.

The ST elevation in $V_{4R}$ has been recognized as a transient phenomenon sometimes disappearing within hours of the onset of chest pain. The mechanism of right-sided ECG changes with inferior wall myocardial infarction is controversial. Some believe ST elevation in $V_{4R}$ may represent transmural ischemia of the right ventricle as opposed to infarction.\textsuperscript{18} Other investigators believe that involvement of the posterior septum during inferior wall infarction may cause an injury wave in $V_{4R}$, as the posterior septum faces the right thoracic leads.\textsuperscript{3,19} The posterior wall of the right ventricle is oriented toward the anterolateral segment of the thoracic wall as well, and potentials from the posterior wall of the right ventricle may thus be seen in the right anterior thoracic leads. Lastly, ST segment deviations in RV lead may reflect reciprocal changes from the opposing wall of the left ventricle with persistent changes due to wall motion abnormalities or aneurysm formation of the opposing wall.

The ST segment depression in the right-sided ECG leads may therefore reflect reciprocal changes of infarction of the opposing left ventricular wall. The current of injury from both an anterolateral and posterolateral myocardial infarction of the left ventricle may result in reciprocal ST segment depression in the right precordial leads and right-sided ECG leads, as demonstrated in our patients. The ST segment depression in right-sided electrocardiographic leads may be transient, as with our patient with anterolateral myocardial infarction, or persistent, as in our patient with posterolateral myocardial infarction with the subsequent development of a posterior aneurysm. These changes may potentially mask the ST segment elevation of right ventricular infarction in these leads.\textsuperscript{20}

Electrocardiographic evidence of right ventricular infarction has been found to be a sensitive and specific marker. The ST segment depression in right-sided ECG leads, however, has not previously been associated with any specific clinical entity. This may be a result of the transient nature of these electrocardiographic changes and/or the infrequent recording of right-sided ECG leads with acute anterior and posterior left ventricular infarctions. The recording of right-sided ECG leads in all acute myocardial infarction patients may therefore have expanded utility beyond the identification of right ventricular involvement in patients with inferior myocardial infarctions. These leads may also detect and localize left ventricular wall infarctions. The significance of ST segment depression in right-sided chest leads and the sensitivity and specificity in regard to left ventricular myocardial infarction awaits further study.

REFERENCES

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