

Combined ST Elevation in a Case of Acute Myocardial Infarction: How to Identify the Infarct-related Artery?

Abstract

Combined ST elevation in anterior and inferior ECG leads in acute myocardial infarction is not a rarity. It is both interesting and challenging to identify the infarct related culprit artery. We report the case of a middle aged male with acute myocardial infarction whose admission ECG shows ST elevation in lead II, III, aVF as well as from V_1 - V_3 . 90% of such cases are due to single vessel occlusion - majority due to proximal RCA occlusion and the remaining due to mid to distal LAD occlusion. ECG features to differentiate between these two vascular occlusions are discussed. In this case at hand, lead III ST elevation of 2.5 mm and $V_2/V_3 \geq 1$ indicates proximal RCA as the IRA and the same has been confirmed by pre-discharge coronary angiogram.

Keywords: Distal left anterior descending occlusion, infarct-related artery, proximal artery occlusion, ST elevation

Introduction

ST-segment depression in inferior leads in patients with acute anterior wall myocardial infarction is well known and there is extensive literature on that issue. However, there are limited data on cases of combined ST elevation in anterior and inferior leads and its significance.

In this case report, we present the electrocardiogram (ECG) features of combined ST elevation in anterior and inferior leads in a middle-aged male with acute myocardial infarction. Applying the available ECG criterion, we localized proximal right coronary artery (RCA) occlusion as the infarct-related artery (IRA) and the same was confirmed by coronary angiogram. There is a plenty of literature on quantifying the extent of acute myocardial infarction and its prognosis based on the magnitude and number of leads showing ST elevation. However, the same cannot be extrapolated to other cases. In our case report, combined elevations of ST segments are seen, but it was due to single-vessel occlusion with good prognosis despite numerous leads showing ST elevation.

Case Report

A 44-year-old male presented to the

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emergency room with anginal chest pain of 3-h duration. He is a chronic smoker and not a known case of hypertension or diabetes.

Admission ECG [Figure 1] showed sinus bradycardia at a rate of 60/min with first-degree AV block and ST-segment elevation in II, III, and aVF with reciprocal ST depression in I and aVL. ST-segment elevation in V_1 , V_2 , and V_3 is also seen. ST elevation in lead III is 2.5 mm, and it is more than ST elevation in lead II (1.5 mm). ST elevation in V_2 (4.0 mm) is more than that in V_3 (3.0 mm).

Lead RV_4 [Figure 2] done at admission shows 1-mm ST elevation with biphasic T-wave suggestive of right ventricular infarction. An ECG [Figure 3] repeated an hour after the thrombolysis therapy with streptokinase shows good resolution of ST elevation in II, III, and aVF and almost isoelectric ST in V_1 , V_2 , and V_3 , suggestive of successful thrombolysis. Coronary angiogram done reveals 90% occlusion of proximal RCA [Figure 4] and minimal narrowing of mid-left anterior descending (LAD) [Figure 5].

Discussion

The interesting feature in this ECG is the combined ST elevation in inferior and anterior leads. Sadanandan *et al.*^[1] analyzed

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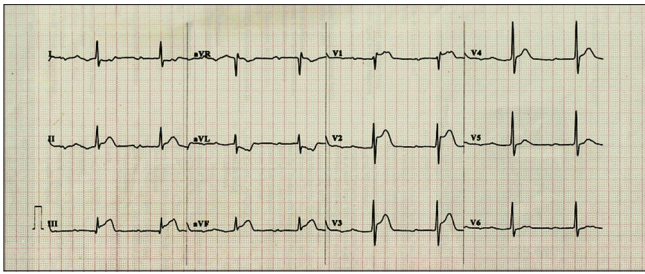


Figure 1: Admission electrocardiogram showing combined ST elevation in II, III, and aVF as well as in V₁, V₂, and V₃

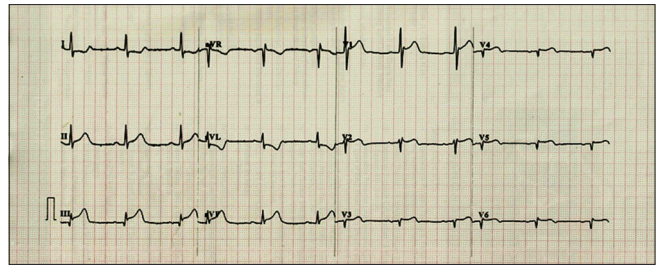


Figure 2: Right-sided V leads done at admission shows 1-mm ST elevation with biphasic T-wave suggestive of right ventricular infarction

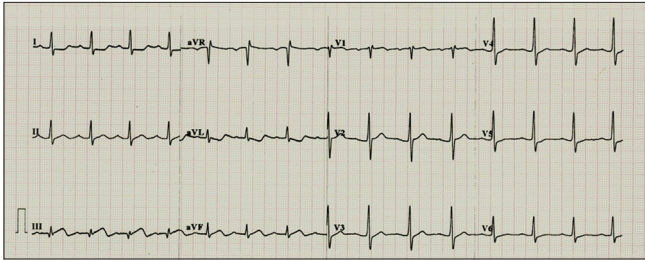


Figure 3: Postthrombolysis electrocardiogram showing good resolution of ST elevation in II, III, and aVF and almost isoelectric ST in V₁, V₂, and V₃

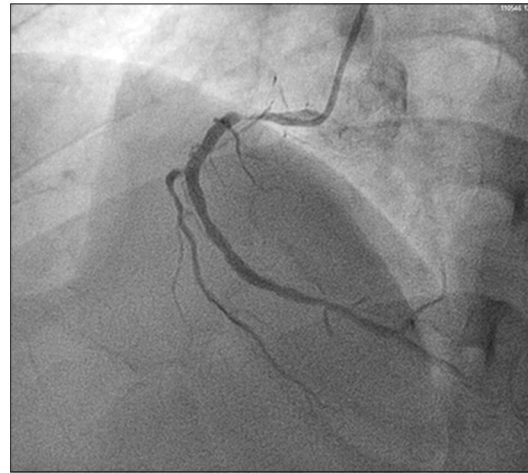


Figure 4: A still from the CAG showing 90% occlusion of the proximal RCA (white arrow)



Figure 5: A still from the CAG showing minimal narrowing of the mid LAD (white arrow)

Mechanisms for the combined anterior and inferior ST elevation

If LAD is the IRA, then distal occlusion of wrapped-up LAD would ideally satisfy the conditions, that is, the inferoapical portion of the left ventricle supplied by the wrap-up LAD would result in ST elevation in II, III, and aVF which would not be neutralized by the superiorly oriented injury current of anterobasal infarction that occurs only with proximal LAD occlusion.^[3] As for proximal RCA, as the IRA, ST elevation in V₁-V₄ occurs because of the right ventricular infarction whose injury current is not counteracted by a large inferoposterior infarction. Furthermore, dilatation of the infarcted right ventricular could manifest as elevated ST in V₁-V₄. Unlike the situation in LAD occlusion, where ST elevation progresses from V₁ to V₅, in RCA occlusion, ST elevation does not progress from V₁ to V₄.

Sadanand *et al.* have noticed that ST elevation V₁ ≥ V₃ differentiates RCA from LAD as the IRA. Jim *et al.*^[2] have suggested that ST-segment elevation in V₂ ≥ V₃ gives better sensitivity (74%) and specificity (92%) in differentiating the IRA. Further, they have concluded that lead III ST elevation ≥ 2.5 mm and the ratio of ST segment in V₂/V₃ ≥ 1 as very specific for RCA as the IRA.

In our case, lead III showing ST elevation of 2.5 mm and V₂/V₃ ≥ 1 indicated RCA as the IRA, which was confirmed

the admission ECGs of 2996 patients with acute myocardial infarction from the GUSTO-1 angiographic substudy and the GUSTO-II angioplasty substudy who underwent immediate angiography and got 179 patients with combined anterior and inferior ST elevation. These patients had either RCA occlusion (59%) or LAD occlusion (36%).

Of the RCA group, 67% had proximal location of block, and of the LAD group, 70% had mid-to-distal location of block. Jim *et al.*^[2] found 49 cases of combined ST elevation in anterior and inferior leads in their study of acute myocardial infarction. Among these, single-vessel disease is found in 90% of cases. Distal occlusion of a wrapped-up LAD and proximal occlusion of a nondominant RCA are the typical angiographic findings according to them, which more or less correlates with the findings by Sadanand *et al.*

by coronary angiogram. Coronary angiogram showed 99% lesion in the proximal RCA. Mid-RCA also showed diffuse mild disease. The mid-LAD showed about 40% lesion. The left circumflex did not show any significant lesion.

Implications for practice

What is known about such cases?

ST-segment depression in inferior leads in patients with acute anterior wall myocardial infarction is well known and there is extensive literature on that issue. However, there are limited data on cases of combined ST elevation in anterior and inferior leads and its significance.

What is the key finding in this case report?

In this case report, we present the ECG features of combined ST elevation in anterior and inferior leads in a middle-aged male with acute myocardial infarction. Applying the available ECG criterion, we localized proximal RCA occlusion as the IRA and the same was confirmed by coronary angiogram.

What are the implications for future practice?

There is plenty of literature on quantifying the extent of acute myocardial infarction and its prognosis based on the magnitude and number of leads showing ST elevation. However, the same cannot be extrapolated to other cases. In our case report, combined elevations of ST segments are seen, but it was due to single-vessel occlusion with good prognosis despite numerous leads showing ST elevation.

Hence, we conclude that our case report exemplifies the rules:

1. ECG pattern showing combined elevation in anterior and inferior leads is usually due to single-vessel occlusion
2. ST elevation in lead III ≥ 2.5 mm and ST elevation $V_2/V_3 \geq 1$ in such cases point to RCA as the IRA.^[4-6]

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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