CASE REPORT

Right Ventricular Infarction Mimicking Anterior Infarction

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It is rare to observe ST elevation in anterior derivations caused by right ventricular branch occlusion. We described the case of a patient with unstable angina who developed acute right ventricular myocardial infarction with ST-segment elevation in anterior precordial leads (V_1 – V_4) shortly after coronary angiography. Coronary angiogram revealed total occlusion of the right coronary artery (RCA) proximally to the right ventricular branch. This reminds us that the presence of diffuse ST-segment elevation in the precordial leads could be due to acute RCA occlusion. The differentiation of these two entities is important, as their therapies are quite different. **A.N.E. 2006;11(2):194–197**

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A 52-year-old male patient was admitted to our hospital with a history of unstable angina Braunwald Class I for coronary angiography. Physical examination findings, blood pressure, and heart rate were normal. His electrocardiogram (ECG) showed normal sinus rhythm without ECG abnormalities (Fig. 1A). A two-dimensional echocardiographic study was significant only for mild hypokinesia in the inferior wall with an ejection fraction of 50%.

A left coronary angiography was performed, with nonionic contrast medium, and revealed a 40–50% stenosis at the middle part of the left anterior descending artery (LAD), a 40–50% stenosis at the proximal part of the first diagonal branch, and a subtotal occlusion at the proximal part of the left circumflex artery (LCX) (Fig. 2A). A right coronary angiography revealed a 90% stenosis at the proximal part of the right coronary artery (RCA), a 95% eccentric stenosis at the middle RCA at the level of right ventricular branch, and a 95% stenosis at the distal part (Fig. 2B). Left ventriculography was performed afterward and revealed hypokinesia in the inferior wall with an ejection fraction of 45%.

While reviewing the case in order to decide for a staged interventional procedure the patient complained of crescendo angina. ECG showed sinus bradycardia, a 1.5 mm ST elevation in the inferior leads (II, III, aVF), a 2–3 mm of ST-segment elevation in precordial leads V_1 – V_4 and ST depression in lateral leads. (Fig. 1B). His blood pressure dropped to 95/60 mmHg and his monitor showed transient Mobitz II block. The patient was transferred again in the cath lab for primary percutaneous transluminal coronary angioplasty (PTCA) of RCA and reevaluation of the LAD anatomy. Repeat angiography was performed, and showed normal Thrombolysis In Myocardial Infarction (TIMI) flow and no change in the degree of stenosis in the mid-LAD, but complete occlusion of the proximal RCA with obliteration of the right ventricular branch. We proceeded immediately with PTCA in the RCA (Fig. 2C). At the proximal lesion of the RCA a TAXUS 3.5/15 mm stent was implanted, at the middle part 3.5/18 and 3.0/18 mm TAXUS stents, and at the distal part proximally to the posterior descending artery a TAXUS stent of 3.0/18 mm, with a good final angiographic result. Restoration of flow was

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Figure 1. (A) ECG on admission showing normal sinus rhythm without ECG abnormalities. (B) Sinus bradycardia, 1.5 mm ST elevation in the inferior leads, 2–3 mm of ST-segment elevation in precordial leads V₁–V₄ and a ST depression in lateral leads. (C) Resolution of ST elevation in leads V₁–V₄.

obtained, although a small acute marginal branch in the distal portion of RCA was stent-jailed (Fig. 2D). The patient was started on IIb/IIIa inhibitors and was relieved of chest pain. His ECG in the coronary care unit showed resolution of ST elevation in leads V₁–V₄ (Fig. 1C).

Due to the subtotal occlusion and the impairment of flow (TIMI II) in the LCX, PTCA was also successfully performed at the same time with a TAXUS stent implantation of 3.5/15 mm.

The patient remained asymptomatic during the rest of his hospitalization, he had less than twice creatine phosphokinase (CPK) elevation, and his ECG remained unchanged. He was treated with aspirin, clopidogrel, beta-blocker, and statin; and was discharged asymptomatic after 2 days.

At 6 months, the patient remained asymptomatic with full recovery of his left ventricular function (EF: 60%) and a negative for ischemia exercise thallium stress test.

DISCUSSION

The purpose of this article is to present an acute RCA occlusion accompanied with ECG changes suggestive of acute inferior and anterior myocardial infarction. In the presence of acute inferior myocardial infarction, ST-segment elevation of 1 mm or more in the right-sided precordial leads, especially in V₄R, is the most sensitive indication of occlusion of the proximal RCA with a sensitivity of 82–100% and a specificity of 68–77%.^{1–3} ST-segment elevation in V₄R serves to identify those patients with an inferior acute myocardial infarction who are likely to have concomitant right ventricular involvement. It probably represents ischemic injury of the posterobasal septum, since this area of contiguous myocardium is invariably damaged in patients with pathologic evidence of inferior acute myocardial infarction with right ventricular infarction. It would, therefore, be desirable to include lead V₄R in the routine ECG in patients with anterior–inferior acute myocardial infarction for the purpose of recognizing possible right ventricular involvement. Additionally, ST elevation in V₁ has been shown to be a new criterion for the detection of the location of occlusion in RCA compared to the criteria based only on ST changes in lateral leads highly specific for proximal RCA occlusion.^{1–3}

The ECG presentation may lead to the false diagnosis of two vessel occlusive disease: RCA and LAD. Classically, the appearance of ST-segment elevation in precordial leads V₁–V₃ is highly suggestive, if not diagnostic, of acute anteroseptal left ventricular infarction secondary to LAD occlusion. Transmural injury of the right ventricle translates into ST elevation ≥ 1 mm precordial leads. In approximately 7% of patients, ST elevation extends to lead V₅, suggesting anterior infarction. However, this ST elevation decreases toward V₄, whereas in anterior injury the ST segment is more elevated in V₂–V₃ than in V₁. Specifically, distal LAD occlusions, in addition to ST elevation or T wave inversion in V₄–V₆ usually have ST elevation in V₂, which is less than ST elevation in V₃. Indeed, in some cases, RCA occlusion may present as

Figure 2. (A) A 40–50% stenosis at the middle part of the left anterior descending artery, 40–50% stenosis at the proximal part of the first diagonal branch, subtotal occlusion at the proximal part of the left circumflex artery. (B) A 90% stenosis at the proximal part, 95% eccentric stenosis at the level of right ventricular branch, and 95% stenosis at the distal part. (C) Complete occlusion at the proximal part. (D) Restoration of flow.

anteroseptal myocardial infarction if right ventricular branch is occluded.^{4–8}

In this case, apart from the culprit lesion that was at the mid-RCA, the patient had also a nonculprit lesion at the mid part of the LCX. Due to impaired TIMI flow and the presence of subtotal occlusion, the nonculprit lesion was also treated with PTCA. LCX has a broad anatomic variability and supplies a rather small ventricular area. In less than half of the cases, LCX occlusion shows ST elevation. When present, ST elevation is more often seen in leads II, III, and aVF, followed by leads V₅, V₆, and aVL. In our case, we did not observe ST elevation in V₅, V₆, and aVL. Furthermore, LCX was patent (TIMI flow II) at the beginning of the procedure.

Coronary angiogram is the only diagnostic technique that can undoubtedly clarify the culprit vessels. In this case, coronary arteriogram revealed complete occlusion of the proximal RCA but normal flow in LAD. Therefore, it may be concluded that the changes consistent with acute anteroseptal infarction were the results of right ventricular in-

farction that was associated with the acute inferior infarction. Indeed his ECG confirmed resolution of ST elevation after restoration of patency and flow in the first right ventricular branch.

There are some questions on what led to the occlusion of RCA immediately after the coronary angiogram. Although mild trauma to the ostium of the RCA by the diagnostic catheter cannot be excluded as a cause of the acute occlusion, the rather long time interval from the right coronary instrumentation to the development of symptoms and the absence of flow disturbances during the procedure make this possibility rather unlikely. On the contrary, clinical observations have shown that ionic radiographic contrast media may influence thrombus formation.^{9,10} Indeed, our patient received a nonionic contrast agent during coronary angiography and ventriculography. Newer ionic agents have shown to be safer than conventional nonionic agents especially, in high risk for acute coronary thrombosis patients, although this issue has not been tested in randomized control trials.

REFERENCES

1. Lopez-Sendon J, Coma-Canella I, Alcasena S, et al. Electrocardiographic findings in acute right ventricular infarction: Sensitivity and specificity of electrocardiographic alterations in right precordial leads V₄R, V₃R, V₁, V₂, and V₃. *J Am Coll Cardiol* 1985;6:1273-1279.
2. Fiol M, Carillo A, Cygankiewicz I. New criteria on ST changes in 12-lead surface ECG to detect proximal versus distal right coronary artery occlusion in case of acute inferior myocardial infarction. *Ann Noninvasive Electrocardiol* 2004;4:383-388.
3. Braat SH, Brugada P, den Dulk K, et al. Value of lead V₄R for recognition of the infarct coronary artery in acute inferior myocardial infarction. *Am J Cardiol* 1984;53:1538-1541.
4. Liu CJ, Ko YL, Chiang CW. Unusual electrocardiographic manifestations in acute isolated right ventricular infarction. *Chang Gung Med J* 2001;24:446-450.
5. Porter A, Herz I, Strasberg B. Isolated right ventricular infarction presenting as anterior wall myocardial infarction on electrocardiography. *Clin Cardiol* 1997;20:971-973.
6. Carroll R, Sharma N, Butt A, Hussain KM. Unusual electrocardiographic presentation of an isolated right ventricular myocardial infarction secondary to thrombotic occlusion of a non-dominant right coronary artery—a case report and brief review of literature. *Angiology* 2003;54:119-124.
7. Inoue K, Matsuoka H, Kawakami H, et al. Pure right ventricular infarction. *Circ J* 2002;66:213-215.
8. Acikel M, Yilmaz M, Bozkurt E, et al. ST segment elevation in leads V₁ to V₃ due to isolated right ventricular branch occlusion during primary right coronary angioplasty. *Catheter Cardiovasc Interv* 2003;60:32-35.
9. Al Dieri R, Beguin S, Hemker HC. The ionic contrast medium ioxaglate interferes with thrombin-mediated feedback activation of factor V, factor VIII and platelets. *J Thromb Haemost* 2003;1:269-274.
10. Scheller B, Hennen B, Pohl A, et al. Acute and subacute stent occlusion; risk-reduction by ionic contrast media. *Eur Heart J* 2002;23:175-177.