Case Reports

Acute Isolated Right Ventricular Infarction:

Unusual Presentation of Anterior ST-Segment-Elevation Myocardial Infarction

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Acute right ventricular infarction presenting with ST-segment elevation in the anterior precordial electrocardiographic leads is an unusual event. Anterior ST-segment elevation typically suggests occlusion of the left anterior descending coronary artery. It should be recognized, however, that occlusion of a right coronary artery branch can cause isolated ST-segment elevation in leads V_1 and V_2 on a standard 12-lead electrocardiogram. We describe the cases of 2 patients who presented with acute chest syndrome with isolated ST-segment elevation in leads V_1 and V_2. Emergency coronary angiograms revealed that acute thrombotic occlusion of the right ventricular marginal branch of the dominant right coronary artery caused the clinical manifestations in the first patient, whereas occlusion of the proximal nondominant right coronary artery was the culprit lesion in the second patient. Both lesions caused right ventricular myocardial infarction. The patients underwent successful primary percutaneous coronary intervention. These cases illustrate the importance of carefully reviewing angiographic findings to accurately diagnose an acute isolated right ventricular myocardial infarction, which may mimic the electrocardiographic features of an anterior-wall myocardial infarction. ***(Tex Heart Inst J 2019;46(2):151-4)***

Key words: *Angina, unstable/physiopathology; coronary occlusion/diagnosis; diagnosis, differential; diagnostic errors/prevention & control; electrocardiography; myocardial infarction/pathology/therapy; ST-elevation myocardial infarction/diagnosis; stents; treatment outcome; ventricular function, right*

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ST-segment elevation (STE) in precordial electrocardiographic (ECG) leads V_1 and V_2 typically indicates occlusion of the left anterior descending coronary artery (LAD). However, in rare cases, isolated STE in these leads has been associated with acute right ventricular (RV) marginal branch occlusion,[1-7] because leads V_1 and V_2 lie directly over the RV.

We describe the cases of 2 patients who presented with acute STE in leads V_1 and V_2 caused by occlusion, involving the RV marginal branch of the dominant right coronary artery (RCA) in the first case and the proximal nondominant RCA in the second case. The patients were treated by means of primary percutaneous coronary intervention (PCI). These cases highlight the importance of considering an RCA occlusion as a potential cause of isolated RV myocardial infarction when ECG features suggest an acute anterior-wall STE myocardial infarction (STEMI). Recognizing this pattern in patients with acute STEMI can help to identify the culprit arteries for timely initiation of reperfusion therapy.

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Patient 1

In December 2016, a 52-year-old obese man presented at our hospital with a 90-minute history of acute left-sided neck and upper chest pain. Standard 12-lead ECG showed STE in leads V_1 and V_2 (Fig. 1). Emergency coronary artery angiograms revealed a smooth, nonthrombotic mid-LAD stenosis of intermediate severity (70%), an anomalous origin of the left circumflex coronary artery from the proximal RCA, nonobstructive atherosclerotic plaque in the dominant RCA, and acute thrombotic occlusion of the proximal RV branch (Fig. 2).

We used a 2 × 23-mm bare-metal MultiLink Vision® coronary stent (Abbott Vascular) to treat the proximal RV branch occlusion and achieved a good angiographic result. After stenting, coronary artery angiograms showed normal flow of the proximal RV branch (Fig. 3). The patient's chest pain resolved immediately, and complete resolution of the STE was noted on telemetry.

The fractional flow reserve of the mid-LAD stenosis was abnormal, with a value of 0.68. Direct stenting of the LAD with use of a 3 × 20-mm Synergy® everolimus-

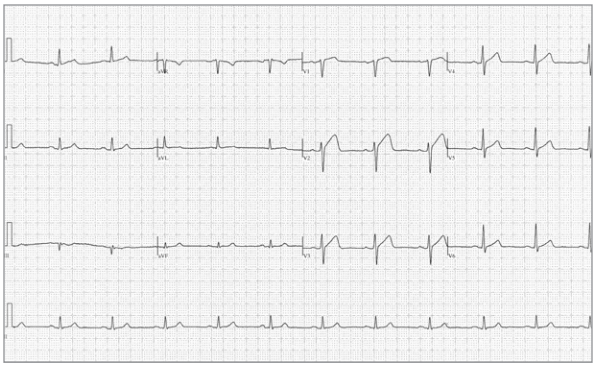

Fig. 1 *Patient 1. Presenting 12-lead electrocardiogram shows ST-segment elevation in leads V_1 and V_2 (gain, 10 mm/mV; paper speed, 25 mm/s).*

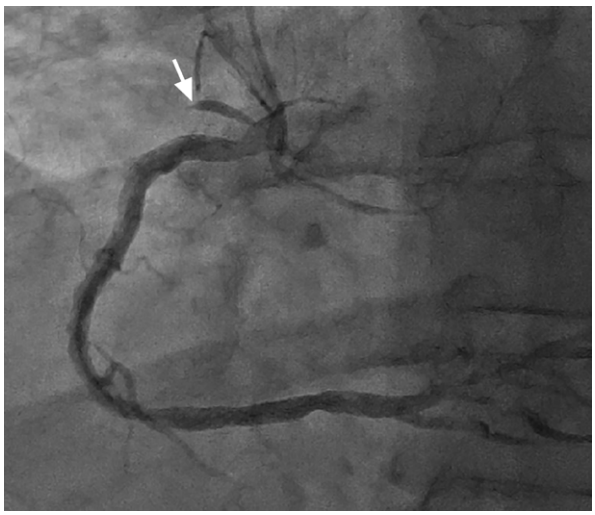

Fig. 2 *Patient 1. Coronary angiogram shows acute occlusion (arrow) of the proximal right ventricular branch arising from the proximal dominant right coronary artery. An anomalous left circumflex coronary artery originates from the inferior portion of the ostial right coronary artery.*

eluting stent (Boston Scientific Corporation) achieved a good outcome. A postprocedural ECG showed resolution of the STE in leads V_1 and V_2 (Fig. 4). At his 1-, 6-, and 12-month follow-up evaluations, the patient was stable, with no recurrent anginal symptoms.

Patient 2

In September 2017, a 59-year-old woman with a history of diabetes mellitus, hypertension, hyperlipidemia, obesity, and long-term smoking presented with an 8-hour history of continuous, severe substernal chest pain that radiated to the shoulders and jaws bilaterally. A standard 12-lead ECG showed mild STE in leads V_1 and V_2 (Fig. 5). Emergency coronary artery angiograms showed acute occlusion of the proximal portion of the nondominant RCA (Fig. 6) and nonobstructive atherosclerotic plaque in the left coronary artery. We

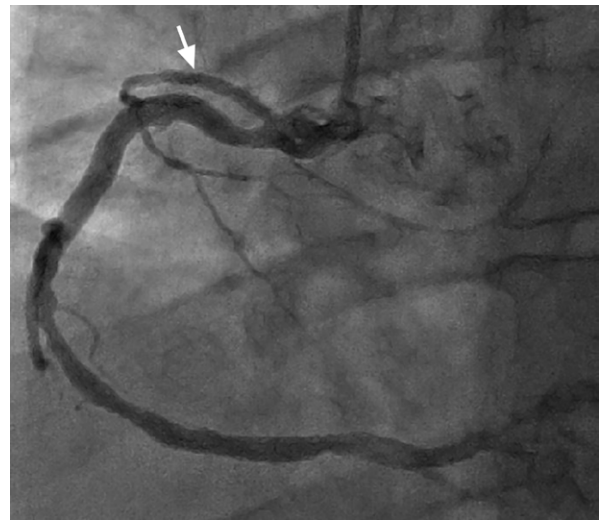

Fig. 3 *Patient 1. Coronary angiogram shows a patent right ventricular branch after coronary stenting (arrow).*

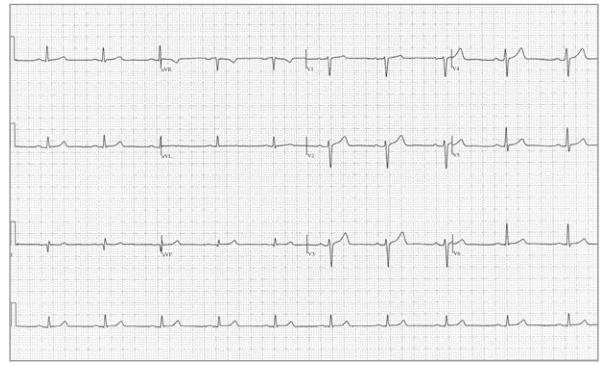

Fig. 4 *Patient 1. After stenting of the occluded right ventricular branch, 12-lead electrocardiogram shows resolution of the ST-segment elevation in leads V_1 and V_2.*

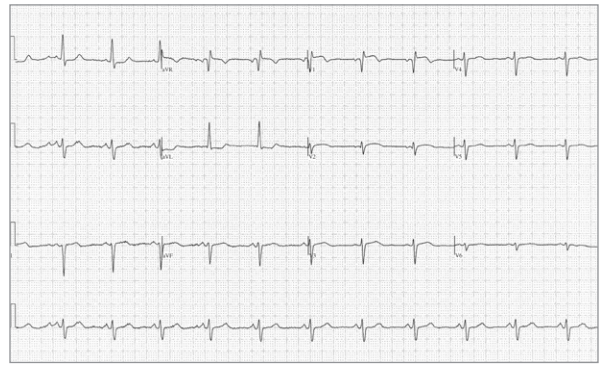

Fig. 5 *Patient 2. Presenting 12-lead electrocardiogram shows ST-segment elevation in leads V_1 and V_2.*

performed PCI on the proximal portion of the RCA with use of a 2 × 23-mm bare-metal MultiLink Vision stent and achieved a good angiographic result (Fig. 7). The procedure resulted in immediate resolution of

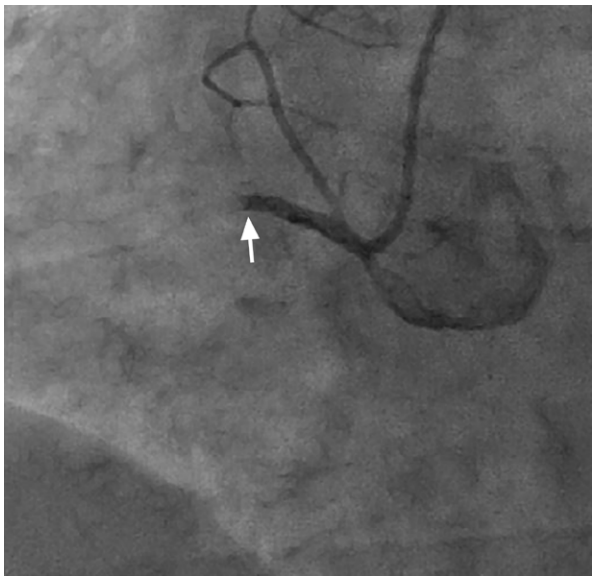

Fig. 6 *Patient 2. Coronary angiogram shows acute occlusion (arrow) of the proximal nondominant right coronary artery.*

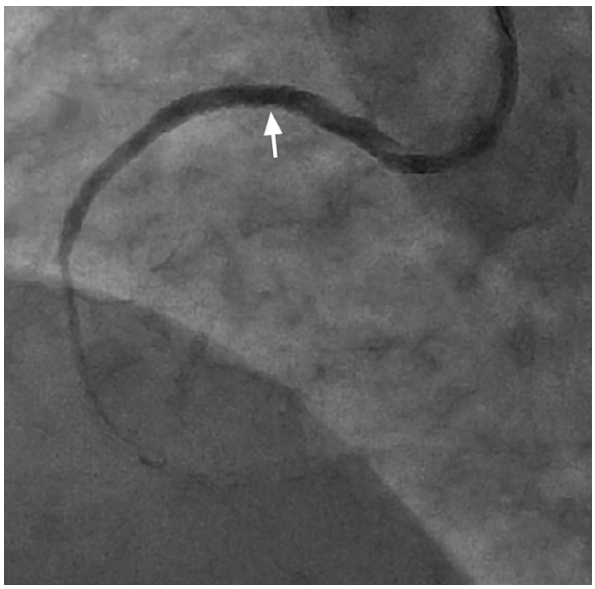

Fig. 7 *Patient 2. Coronary angiogram shows the nondominant right coronary artery after coronary stenting (arrow).*

the patient's chest pain. A postprocedural ECG showed improvement in, but not resolution of, the STE in leads V_1 and V_2 (Fig. 8). Echocardiograms showed moderate RV free-wall hypokinesis and normal left ventricular (LV) systolic function. At her 1-, 6-, and 12-month follow-up evaluations, the patient was stable and had no recurrent anginal symptoms.

Discussion

Two patients presented at our hospital with STE in leads V_1 and V_2, which typically suggests an acute LAD occlusion. However, these ECG changes resulted from an occlusion of the RV marginal branch of the dominant RCA in the first instance and a blockage of the proximal nondominant RCA in the second.

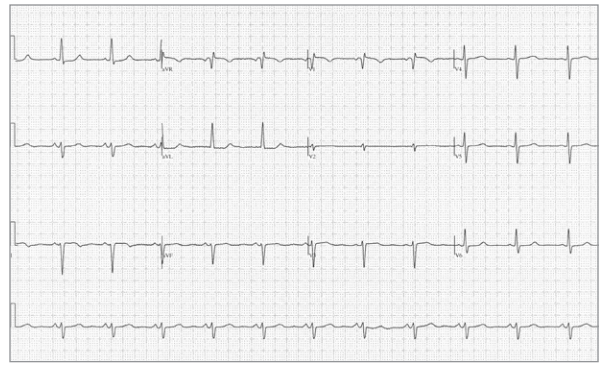

Fig. 8 *Patient 2. After stenting of the occluded proximal nondominant right coronary artery, 12-lead electrocardiogram shows improvement in the ST-segment elevation in leads V_1 and V_2.*

Isolated RV infarction occurs in fewer than 3% of all patients with myocardial infarction.[2] Acute occlusion of a nondominant RCA[3] and occlusion of the RV marginal branch during PCI of the mid-RCA[4] have been described. However, isolated STE associated with RV myocardial infarction is an unusual event. Because RV myocardial infarction most often occurs simultaneously with an inferior LV wall infarction involving an occlusion of the proximal dominant RCA, the current of injury from the inferior wall of the LV dominates the electrical forces.[5] Certain ECG features have been proposed as a means to differentiate between these 2 types of RV involvement; however, the proposed features are nonspecific. An STE of 1 mm or greater in the right-sided precordial leads, especially in V_4R, is the most sensitive indicator of an occlusion of the proximal RCA, with a sensitivity of 82% to 100% and a specificity of 68% to 77%.[2] ST-segment elevation in V_4R can identify patients with an acute inferior-wall myocardial infarction who are likely to have concomitant RV involvement. In addition, the absence of inferior STE has been shown to support the diagnosis of isolated acute RV myocardial infarction.[6]

Acute anterior STE typically suggests occlusion of the LAD. Electrocardiographic criteria have been used to differentiate an acute occlusion of the LAD from an occlusion of the RV marginal branch.[7] Some investigators have suggested that the latter typically lacks reciprocal changes on the ECG, as we observed in our patients. Others have reported that STE primarily in V_1 suggests an isolated RV infarction because lead V_1 directly faces the RV.[8] Another group reported that decreasing STE from lead V_1 to lead V_3 is a pattern specific to isolated RV myocardial infarction.[9] We observed this pattern in Patient 2, but not in Patient 1.

The cases that we have described illustrate the rare occurrence of isolated anterior STE correlated with acute RV marginal branch or proximal nondominant RCA occlusion causing acute RV myocardial infarction. In Patient 1, an interventionalist may have been tempted to treat only the chronic mid-LAD disease, without treating the acute culprit lesion. In both cases, treatment of the culprit occlusions, which restored blood flow to the patients' RVs, effectively relieved their acute chest pain and improved the STE.

Coronary angiography is the only diagnostic technique that can unequivocally identify the vessels causing infarction. However, acute occlusion of a relatively small RV marginal branch may be subtle. Other groups have reported a similar ECG pattern with acute occlusion of the conus branch of the RCA, which was identified by using cardiac magnetic resonance.[10] The correct diagnosis could easily have been missed in this situation had it not been suspected. Primary PCI of the culprit vessels enabled a reduction in STE and resolution of the symptoms.

Our cases highlight the importance of recognizing the RV marginal branch and the nondominant RCA as the potential sites of the culprit lesions in patients presenting with ECG findings that suggest an acute anterior STEMI. An isolated RV infarction may be caused by acute thrombotic occlusion of either an RV marginal branch or of a nondominant RCA, because both vessels supply only the RV free wall. Carefully reviewing angiographic images in conjunction with clinical symptoms and ECG features can facilitate identifying the infarct-related artery.

Acknowledgment

We acknowledge the outstanding care provided by the Cardiac Catheterization Laboratory team at St. Joseph Hospital to patients with acute myocardial infarction.

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