

CASES AND TRACES

The Right-Sided ECG for the Right Diagnosis

ECG CHALLENGE

A 64-year-old woman with a history of diabetes mellitus and hypertension presented to the emergency department with substernal chest pressure radiating to her back and left breast. Blood pressure was equal in both arms, and she was diagnosed with acute myocardial infarction. Despite adequate stent deployment resulting in excellent epicardial coronary artery flow, she developed confusion, hypotension, cool extremities, and an elevated serum lactate. The right-sided ECG in Figure 1 was obtained when she became hemodynamically unstable. Identify all the ECG abnormalities and the best management at this point.

Please turn the page to read the diagnosis.

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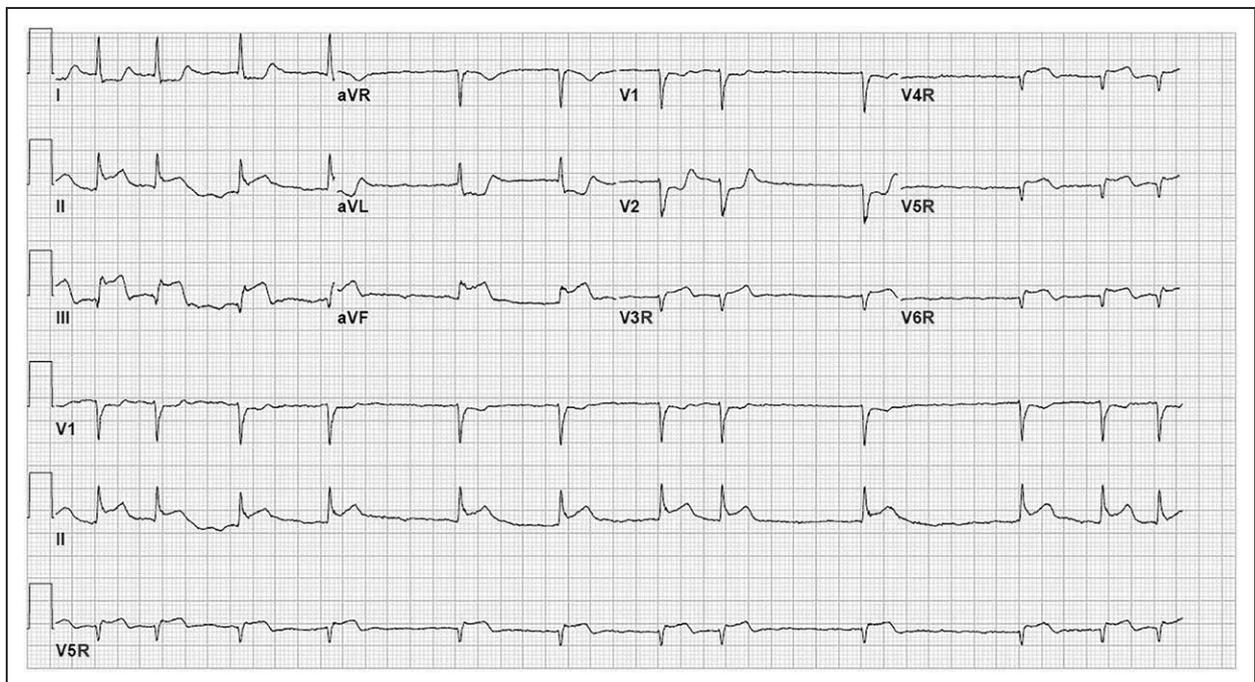


Figure 1. Right-sided ECG performed in a hemodynamically unstable patient. V_3R through V_6R are placed in their standard position along the right chest wall.

RESPONSE TO ECG CHALLENGE

The right-sided ECG presented in Figure 1 shows atrial fibrillation with acute infero-posterior wall ST-segment–elevation myocardial infarction with right ventricular (RV) infarction. This ECG shows remarkable ST-segment elevations in the inferior and right-sided leads with reciprocal ST-segment depressions in the anterior and lateral leads. Maximal ST-segment elevation appears in lead III, ≈ 5 mm in height. V_3R through V_6R show 1.5- to 2-mm ST-segment elevations, consistent with RV infarction.

Her initial ECG obtained on presentation in the emergency department was subtler (Figure 2). She was diagnosed with inferior ST-segment–elevation myocardial infarction and taken for emergent cardiac catheterization, where she was found to have an acutely occluded right coronary artery in the middle segment. During the intervention, she developed complete heart block (ECG not shown) and hypotension complicating slow reflow after stent placement. A temporary transvenous pacemaker and an intra-aortic balloon pump were placed, and she was admitted to the cardiac intensive care unit.

The right-sided ECG was performed after an initial attempt at stabilization in the cardiac intensive care unit and is shown in Figure 1. ST-segment elevations were noted in the right-sided leads along with a dramatic increase in ST-segment elevations in the traditional limb leads and reflected her clinical deterioration. Echocardiogram showed normal left ventricular function, but a dilated RV with reduced function. She remained hypotensive despite aggressive intravenous fluid resuscitation and escalating doses of dopamine, dobutamine, and norepinephrine. She was taken back to the cardiac catheterization laboratory, where the Abiomed right-sided Impella RP device was placed with rapid improve-

ment in perfusion. Repeat catheterization of the right coronary artery showed a widely patent stent. The supporting devices are shown in Figure 3.

Infarction of the RV should be considered in patients with inferior myocardial infarction complicated by cardiogenic shock. In the prospective SHOCK trial (Should We Emergently Revascularize Occluded Coronaries for Cardiogenic Shock) of patients with predominant left ventricular dysfunction and exclusion of isolated RV infarction, 38% developed RV dysfunction, 15% of which were defined as severe RV dysfunction.¹ Mechanical support for the failing RV is increasing in prevalence and experience since the 2015 RECOVER RIGHT trial (The Use of Impella RP Support System in Patients With Right Heart Failure)² showed rapid improvement in central venous pressure and cardiac index with the Impella RP device.

The ECG in Figure 1 is a remarkable manifestation of ST-segment–elevation myocardial infarction pathophysiology of the RV. First, one could infer right coronary artery occlusion over left circumflex artery occlusion given that ST-segment elevations in lead III are greater than in lead II. This finding, combined with ST-segment depression in leads I and aVL and ST-segment elevation in V_1 and V_4R have a reported 100% specificity for right coronary artery infarction.³ Second, the inappropriate vagal tone resulted in the well-described occurrence of complete heart block that was later replaced by atrial fibrillation. Atrial fibrillation in the context of myocardial infarction portends a poor prognosis and is driven by bradycardia, autonomic dysfunction, ischemia, myocyte inflammation, increased atrial pressures, and atrial dilation.³ Third, such marked ST-segment elevations apparent in each right-sided ECG lead are unusual.

The ECG is essential in the initial management of acute coronary syndromes. Although initially subtle inferior ST elevations predominated, the ECG changes

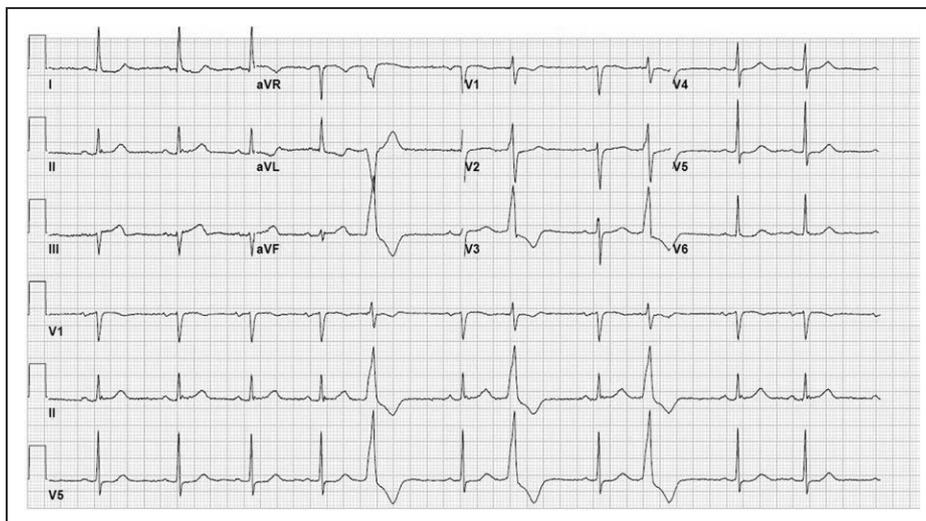


Figure 2. Initial ECG 30 minutes after the onset of chest pressure.

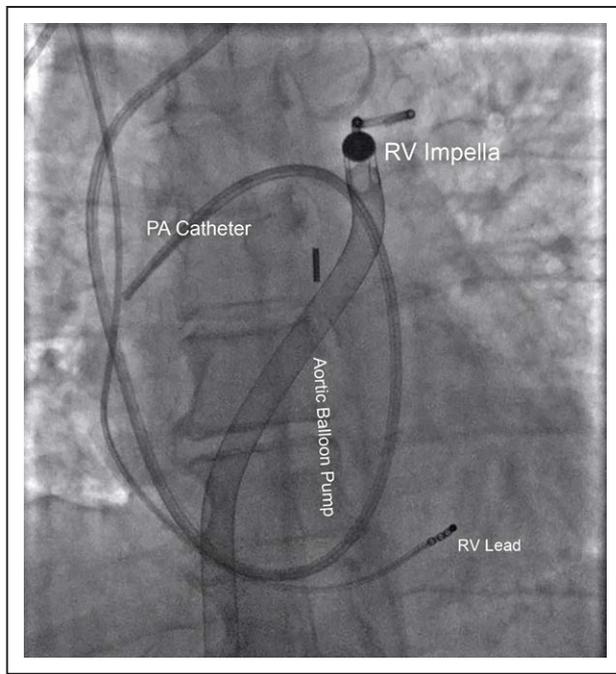


Figure 3. Fluoroscopic image after placement of the right ventricle (RV) Impella RP.

The pulmonary artery (PA) catheter and RV lead of the transvenous pacemaker are also evident in proper position. The inflated aortic balloon pump can be seen below the radiopaque tip.

evolved with the clinical case. The development of RV infarction resulted in profound hemodynamic collapse that correlated with striking ST-segment elevations on the often-subtle right-sided ECG. Prompt recognition, fluid resuscitation, and timely collaboration with the

heart team allowed this patient to be discharged from the hospital in ambulatory condition.

ARTICLE INFORMATION

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Disclosures

None.

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