ECG Diagnosis: Acute Myocardial Infarction in a Ventricular-Paced Rhythm

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CLINICAL MEDICINE

INTRODUCTION

In the Emergency Department, the diagnosis of acute myocardial infarction (AMI) relies initially on a patient’s history and the 12-lead electrocardiogram (ECG). Establishing the diagnosis of AMI in the setting of a ventricular-paced rhythm (VPR) is difficult and can result in delay of definitive treatment. In 1996, Sgarbossa et al 1 published a retrospective study comparing 17 ventricular-paced ECG controls with 17 ventricular-paced ECGs with AMI, confirmed by cardiac biomarkers. The authors found 3 ECG criteria to evaluate for AMI in patients with VPR: 1) ST-segment elevation (STE) greater than or equal to 1 mm for leads with a positive (concordant) QRS complex; 2) ST-segment depression (STD) greater than or equal to 1 mm in leads V1, V2, or V5; and 3) STE greater than or equal to 5 mm in leads with negative (discordant) QRS complexes. These criteria were identical to the criteria Sgarbossa developed to identify AMI in patients with left bundle branch block (LBBB), except the point scoring system was not used when the criteria were applied to patients with VPRs (Figure 1). Only 1 criterion had both relatively high specificity and statistical significance for the diagnosis of AMI at admission in patients with VPRs: STE greater than or equal to 5 mm in leads with a negative QRS complex. We report a case of an 81-year-old woman with a VPR who presented with chest pain, STE greater than or equal to 5 mm in leads with discordant QRS complexes, STE greater than or equal to 1 mm in a lead with concordant QRS complex, and was diagnosed with an AMI on cardiac catheterization. This case demonstrates the utility of Sgarbossa criteria for detecting AMI in patients with a VPR.

CASE PRESENTATION

An 81-year-old woman presented to the Emergency Department by emergency medical services, reporting left-sided chest pain and shortness of breath, which began 3 hours before arrival. She had a medical history significant for a dual-chamber pacemaker for symptomatic complete heart block. She also had chronic obstructive pulmonary disease, congestive heart failure, diabetes mellitus, coronary artery disease, and an STE myocardial infarction (STEMI) 2 weeks earlier, with cardiac stents to the proximal and mid-left anterior descending coronary artery. Her initial vital signs were: Oral temperature, 99 °F (37.2 °C); pulse, 105 beats/min; blood pressure, 189/111 mmHg; respirations, 30 breaths/min; and oxygen saturation, 93% on room air. Physical examination revealed an elderly woman in moderate distress with trace expiratory wheezing on lung examination, and a regular rate and rhythm without murmurs on cardiac examination. The patient was treated with aspirin and sublingual nitroglycerin, and a 12-lead ECG was obtained (Figure 2), which was compared with a previous ECG from this patient 2 weeks earlier following cardiac catheterization (Figure 3). The cardiologist was consulted, and the recommendation was to treat the patient with intravenous heparin and a nitroglycerin infusion. Laboratory test results were significant for troponin I, 0.43 ng/mL (normal range 0.00-0.04 ng/mL), and B-type natriuretic peptide.

Figure 1. Sgarbossa criteria for acute myocardial infarction in the left bundle branch block. Arrows depict elevation or depression of the ST segment.

Figure 2. 12-lead electrocardiogram from an 81-year-old woman with chest pain and shortness of breath for 3 hours. Demonstrates a ventricular-paced rhythm, ventricular rate of 93 beats/min, discordant ST-segment elevation greater than 5 mm in leads V3 and V4, with concordant ST-segment elevation greater than 1 mm in lead V6, and a premature ventricular contraction in leads II and III.

Keywords: acute myocardial infarction, Sgarbossa criteria, ventricular-paced ECG, ventricular-paced myocardial infarction

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3218 pg/mL (normal range < 100 pg/mL). Results of a portable chest radiograph demonstrated moderate pulmonary vascular congestion. The patient received intravenous furosemide and epiftibatide. Because she continued to experience chest pain, she was taken urgently to the cardiac catheterization laboratory. Results of her coronary angiogram demonstrated 100% in-stent thrombosis of the proximal left anterior descending stent. Successful angioplasty and aspiration thrombectomy of the proximal left anterior descending coronary artery lesion were undertaken with restoration of thrombolysis in myocardial infarction (TIMI) III flow. A repeat ECG obtained following percutaneous coronary intervention demonstrated significant reduction of the discordant STEs (Figure 4). The patient was discharged on hospital day 3.

**DISCUSSION**

AMI is more difficult to diagnose in patients with VPRs, often leading to delays in treatment and inferior outcomes.

The Sgarbossa criteria can help identify STEMI in these patients, many of whom may be candidates for timely reperfusion therapy. These criteria were originally developed to determine electrocardiographic criteria for the diagnosis of AMI in the presence of LBBB and used point values to increase specificity (Figure 1). Subsequent analyses have suggested modifications to improve the specificity of the criteria in LBBB.

Sgarbossa et al further applied their criteria to VPRs, as pacing of the ventricle results in an intraventricular conduction delay similar to that seen with LBBB. In the small study examining VPRs, several characteristics of the paced ECG were examined for findings that might predict AMI. The criteria have low sensitivities and cannot be applied to rule out an acute coronary event, but they do have potentially clinically useful specificities: 1) STE greater than or equal to 1 mm for leads with a predominantly positive QRS complex (sensitivity 18%, specificity 94%); 2) STD greater than or equal to 1 mm in leads V₁, V₂, or V₃ (sensitivity 29%, specificity 82%); 3) STE greater than or equal to 5 mm in leads with negative (discordant) QRS complexes (sensitivity 55%, specificity 88%). In a more recent study by Maloy et al, 57 patients with ventricular-paced ECGs and an AMI diagnosed by elevated cardiac markers were identified retrospectively and compared with a control group of 99 patients with ventricular-paced ECGs and negative cardiac markers. For STE greater than or equal to 5 mm discordant with the QRS complex, the sensitivity for detecting AMI was 10% (95% confidence interval = 5%-21%), specificity 99% (95% confidence interval = 93%-99%), with a likelihood ratio of 5.2 (95% confidence interval = 1.3-21%). The authors concluded that the most specific Sgarbossa criterion in identifying AMI was STE greater than 5 mm discordant with the QRS complex.

Stent thrombosis occurs in 1% to 5% of patients, and is associated with medication discontinuation, undersizing of the coronary stent, present malignant disease, and intermediate coronary artery disease proximal to the lesion. A small late stent thrombosis risk remains 5 years after placement at less than 1% per year. Diabetes mellitus is an independent predictor of stent thrombosis within 30 days.

In our case, the patient presented with acute chest discomfort. She had an ECG with a VPR, discordant STE greater than 5 mm in 2 anterior leads (V₁ and V₂), and concordant STE greater than 1 mm STE in V₃, 2 weeks after stent placement. The application of Sgarbossa criteria to the ECG led to a timely diagnosis and prompt reperfusion treatment that might otherwise have been delayed. This case demonstrates the utility of Sgarbossa criteria in patients with VPRs presenting with chest pain or anginal-equivalent symptoms. The third Sgarbossa criterion depicted in Figure 1 (STE ≥ 5 mm discordant with the QRS complex) is the most useful to help rapidly identify Emergency Department patients with VPRs and AMI who may be eligible for early percutaneous coronary intervention. Although current guidelines for the diagnosis and treatment of STEMI do not specifically recognize these ECG findings in a VPR as a true STEMI equivalent, in such cases prompt consultation with the cardiologist is prudent to consider urgent cardiac catheterization.

**Disclosure Statement**

The author(s) have no conflicts of interest to disclose.

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References


