

PR depression with multi-lead ST elevation and ST depression in aVR: Is it always acute pericarditis?

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Abstract:

The classic electrocardiographic (ECG) manifestation of stage I of acute pericarditis is diffuse ST elevation and PR depression with ST depression in lead aVR. One of the most common conditions, that is often confused with acute pericarditis, is the benign diffuse ST elevation, termed “early repolarization with ST elevation” (ERSTE). ERSTE often presents with diffuse ST elevation in the inferior and anterolateral leads, with or without terminal QRS notching or slurring. As ERSTE often presents with ST elevation in leads I and II, frequently there is concomitant ST depression in lead aVR, similar to the acute pericarditis ECG pattern. Moreover, PR depression in the inferior leads and/or PR elevation in lead aVR is often seen. Here we describe four patients with ERSTE, all had ST elevation in II with either ST elevation or isoelectric ST in lead I and concomitant ST depression in aVR. Two also had PR depression in the inferior leads. None of the patients had clinical symptoms or signs of acute pericarditis. In conclusion, diffuse ST elevation in the inferolateral leads associated with ST depression in aVR and even with PR segment depression is commonly found in ERSTE and should not be considered as pathognomonic of only acute pericarditis.

Introduction:

The classic electrocardiographic (ECG) manifestation of stage I of acute pericarditis is diffuse ST elevation and PR depression with ST depression in lead aVR (1,2). One of the most common conditions, that is often confused with acute pericarditis, is the benign diffuse ST elevation, termed “early repolarization with ST elevation” (ERSTE) (3,4). ERSTE often presents with diffuse ST elevation in the inferior and anterolateral leads, with or without terminal QRS notching or slurring (4).

Spodick studied 48 patients with acute pericarditis and 48 with early repolarization and reported that ST depression in lead V1 is seen more often in pericarditis (14 versus 2 patients), whereas isoelectric ST in lead V6 is seen more often in early repolarization (10 versus 1 patients). However, the sensitivity of these signs was low (3). Spodick reported that the mean frontal ST vector was different between the patients with pericarditis and ERSTE. The mean vector was horizontal (0 to +30°) in 25 out of the 48 patients with pericarditis and vertical (+70 to +90°) in 15 of the 27 patients with ERSTE (3). Interestingly, PR depression was observed in both conditions; however, in pericarditis PR depression was found in both the limb and precordial leads, whereas in early repolarization they were confined to either lead group (3). Porela et al also reported that PR depression in both the precordial and limb leads is more often seen with myopericarditis than in ST elevation myocardial infarction (5). Imazio suggested that a ratio of >0.24 of ST segment at the J-point to the T-wave amplitude in leads V5-V6 is seen more often with pericarditis than in early repolarization (1,2).

As ERSTE often presents with ST elevation in leads I and II, frequently there is concomitant ST depression in lead aVR, similar to the acute pericarditis ECG pattern. Lead aVR is a calculated lead, using the minus average of leads I and II (6). Thus, if there is ST elevation in I and II, ST depression must be seen in aVR. However, the literature on early repolarization does not consistently mention ST depression in aVR (3,4) and therefore, it is usually taught that ST depression in aVR is pathognomonic for acute pericarditis.

Here we describe four patients with ERSTE (Figures 1-4), all had ST elevation in II with either ST elevation or isoelectric ST in lead I with concomitant ST depression in aVR. Two also had PR depression in the inferior leads. None of the patients had clinical symptoms or signs of acute pericarditis.

Cases:

Patient #1 is a 47-year old female with controlled hypertension and breast cancer, who had an elective ECG as part of preoperative cardiovascular evaluation before breast reconstructive surgery. ECG is shown in Figure 1. No previous or follow-up ECGs were available.

Patient #2 is a 21-year old male with past medical history of asthma, who presented to the Emergency Department complaining of weakness. Patient denied fever, cough, shortness of breath or chest pain. No friction rub heard. While blood cell count and chest X-ray were normal. ECG is shown in Figure 2. No previous or follow-up ECGs were available.

Patient #3 is a 41-year old male with past medical history of asthma and hypothyroidism presented to the Emergency Department with cough. There was no fever and no friction rub was heard. His white blood cell count was elevated; however, chest X ray was normal. Presenting ECGs is shown in Figure 3a. A previous ECG, recorded 10 months earlier is shown in Figure 2b.

Patient #4 is a 20-year old male with congenital ventricular septal defect, who was asymptomatic and was evaluated for possible elective surgery. Routine ECG is shown in Figure 4. Cardiac MRI did not show pericardial effusion or thickening. The patient underwent elective surgical repair several days later.

Patient #5 is a 56-year old male with end stage renal disease, hypertension, and recent ablation for atrial fibrillation who developed acute pericarditis five days after coronary artery bypass surgery (Figure 5). ECG shows clear QRS notching with ST elevation in the lateral leads, typical for early repolarization. Yet, this patient did not have ERSTE pattern in his previous ECGs. Thus, QRS notching or prominent J-point in the leads with ST elevation does not exclude pericarditis.

Discussion:

The definition of early repolarization has changed over time. The original description was ST elevation in the absence of chest pain (7). Some authors limited it to ST elevation in the inferolateral leads, whereas others have included ST elevation in any leads, including the precordial leads (4). Later it became apparent that the presence of terminal QRS notching and slurring carries prognostic implications and a consensus paper published in 2015 suggested that the term should be used solely for patients with prominent J points, whereas the presence of ST elevation is not a required criterion (8). Yet, a year later a scientific statement on behalf of the American Heart Association broadened the definition again to include all types of ST elevation in the absence of chest pain, terminal QRS slur, or terminal QRS notching (4). They stated that when the term is used, a description should follow to include whether there is ST elevation, terminal QRS notch, terminal QRS slurring or J-point elevation (4).

Here we present four patients with diffuse ST elevation and ST depression in aVR, two of them had PR depression in the inferior leads and three had PR elevation in aVR. None of the patients presented with symptoms or signs compatible with acute pericarditis. The etiology of the ECG pattern in all four was ERSTE.

The underlying mechanism(s) of PR segment deviation in ERSTE is not clear, as the mechanisms for ST elevation are not fully understood. It might be that PR depression is a more common phenomenon than currently appreciated and we have been ignoring minor PR segment deviations, as we have been ignoring ST deviation in lead aVR until recently.

Spodick reported that isoelectric ST in lead V6 was seen more often in early repolarization (21% versus 2% patients) (3). Two of the patients had ST elevation of 1 mm and additional two 0.5 mm in lead V6. Thus, sparing lead V6 is probably not common with ERSTE. Spodick also found that ST depression in lead V1 is seen less often in early repolarization (4% versus 29.4%) (3). Indeed, only one of our patients had ST depression in V1. However, this sign is probably not sensitive. Two out of the four patients (50%) had ST/T ratio above 0.24 in V5 or V6, suggesting that the Imazio sign might not be predictive in our patient population (1,2).

As to the ST vector, Spodick reported that it was vertical ($+70$ to $+90^\circ$) in 15 of the 27 patients with ERSTE (3). This means more ST elevation in the inferior than in the lateral leads. However, this percentage is dependent on the definition of ERSTE and the inclusion criteria of the patients. As abovementioned, the definitions have changed over time. However, in patients with the classical pattern of ST elevation in the lateral leads, the ST vector should be lateral, as was found in 12 out of the 27 patients described by Spodick.

Recently, Dehghani Mohammadabadi described a patient with acute pericarditis and ERSTE. After resolution of the pericarditis the ECG showed the ERSTE pattern. Both the presenting and pre-discharge ECG showed ST depression in lead aVR (9). Actually, the two ECG samples presented by Spodick show ST depression in lead aVR. However, this is not mentioned in the text (3). Mehta et al also described “reciprocal” ST depression in lead aVR in up to 50% of the patients with early repolarization (10,11). They used the more general definition of early repolarization and included many patients with ST elevation limited to the right precordial leads V1-V3 in their series. Other investigators called this pattern of ST elevation limited to the anterior leads “a normal variant” and distinguished it from the classical pattern of ERSTE (12,13). It is probable that the incidence of ST depression in aVR could have been much higher in the subset of patients with ST elevation in the inferolateral leads. The only comment that we were able to find on “reciprocal” ST depression in aVR in the benign form of ERSTE is by Perez-Riera et al (14).

Limitations: The four cases presented do not represent a cohort of consecutive patients with ERSTE. Thus, the true prevalence of ST depression in aVR and PR deviation cannot be assessed. It is expected that the percentage of patients showing these changes will depend on the inclusion criteria for ERSTE (all patients with non-ischemic ST elevation versus the more typical pattern of prominent J-point or notching with ST elevation in the inferolateral leads). Moreover, we cannot fully exclude that some of the cases presented had subclinical pericarditis. However, this limitation holds for every clinical trial including “healthy” or “normal” subjects (heart catheterization, echocardiogram and cardiac MRI are not used for excluding subclinical abnormalities).

In conclusion, diffuse ST elevation in the inferolateral leads associated with ST depression in aVR and even with PR segment depression is commonly found in ERSTE and should not be considered as pathognomonic of only acute pericarditis.

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Figure 1: Sinus rhythm, PR depression in II, aVF and V3-V6 with minimal PR elevation in aVR. There is end-QRS notching with ST elevation in leads I, II, aVF, V3-V5, and end-QRS slurring in V6. There is ST depression in aVR and V1. ST in V5 is 1.0 mm and T wave amplitude is 6.0 mm (ST/T ratio 0.17). ST in V6 is 0.5 mm and T wave amplitude 4.0 mm (ST/T ratio 0.125).

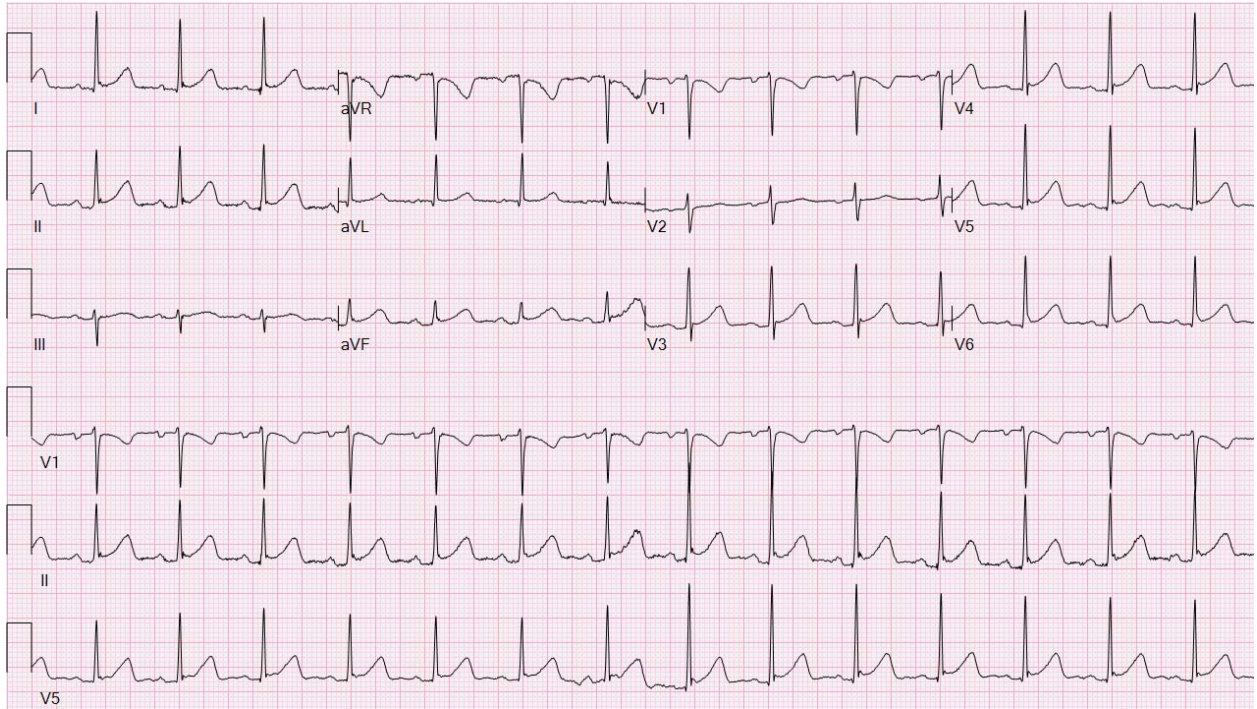


Figure 2: Sinus rhythm. There is minimal PR elevation in aVR. There is right axis deviation, which can be normal for the age. End-QRS notching with ST elevation in leads II, III and aVF, V4-V6 is seen. There is mild ST depression in aVR. ST in V5 is 1.0 mm and T wave amplitude is 4.0 mm (ST/T ratio 0.25). ST in V6 is 1.0 mm and T wave amplitude 2.5 mm (ST/T ratio 0.4).

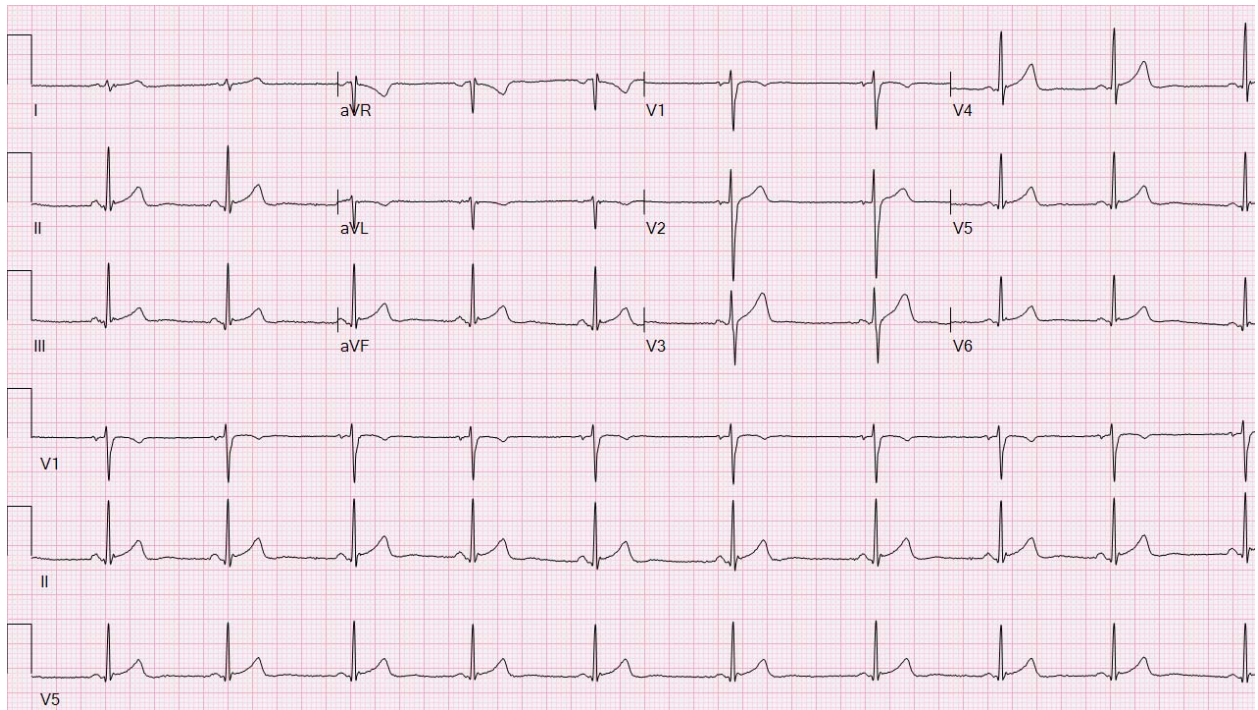


Figure 3: a) Sinus rhythm with notched P waves and PR depression in the inferior leads and V3-V6 and mild PR elevation in aVR. There is end-QRS slurring with ST elevation in leads II, III and aVF and end-QRS notching with ST elevation in V4-V6. In addition, there is PR elevation and ST depression in lead aVR. ST in V5 is 0.5 mm and T wave amplitude is 2.0 mm (ST/T ratio 0.25). ST in V6 is 1.0 mm and T wave amplitude 1.5 mm (ST/T ratio 0.67). **b)** A previous ECG, recorded 10 months earlier showed a similar pattern of ERSTE.

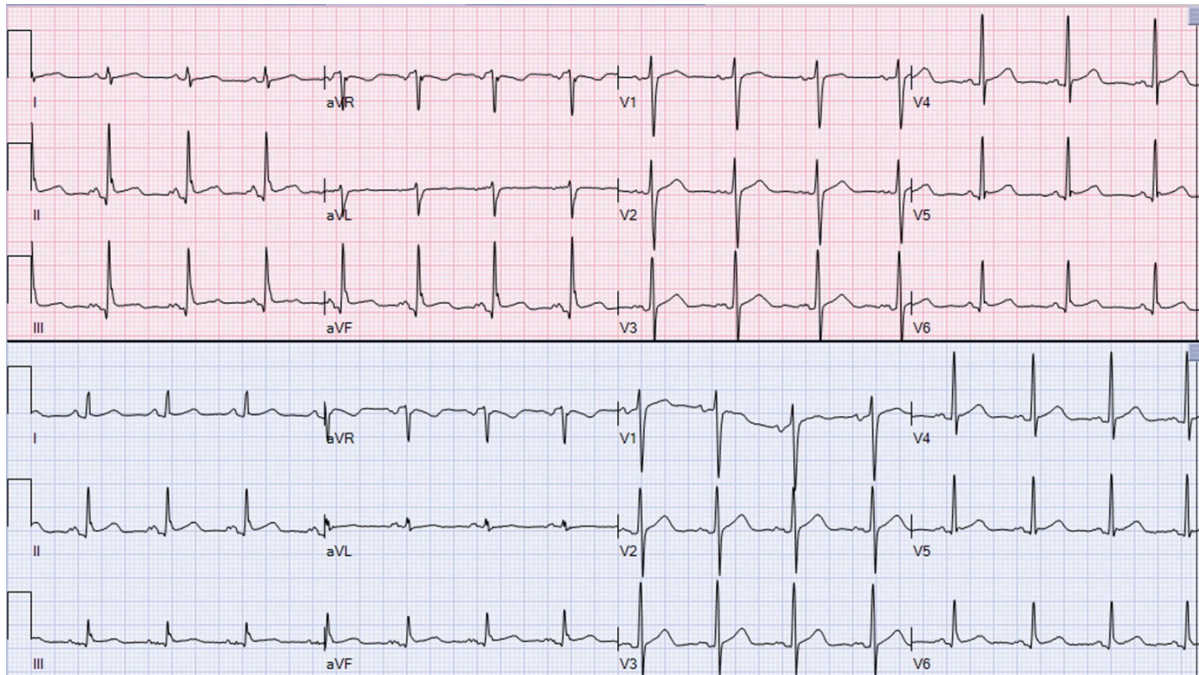


Figure 4: Sinus rhythm. There is minimal PR elevation in aVR and minimal PR depression in lead II. There are Sokolow-Lyon voltage criteria for left ventricular hypertrophy. There is mild end-QRS notching in leads II, aVF, V5-V6, mild J-point elevation in V1, with ST elevation in I, II, aVF, V1-V6. There is ST depression in aVR. ST in V5 is 1.0 mm and T wave amplitude is 9.0 mm (ST/T ratio 0.11). ST in V6 is 0.5 mm and T wave amplitude 6.0 mm (ST/T ratio 0.08).

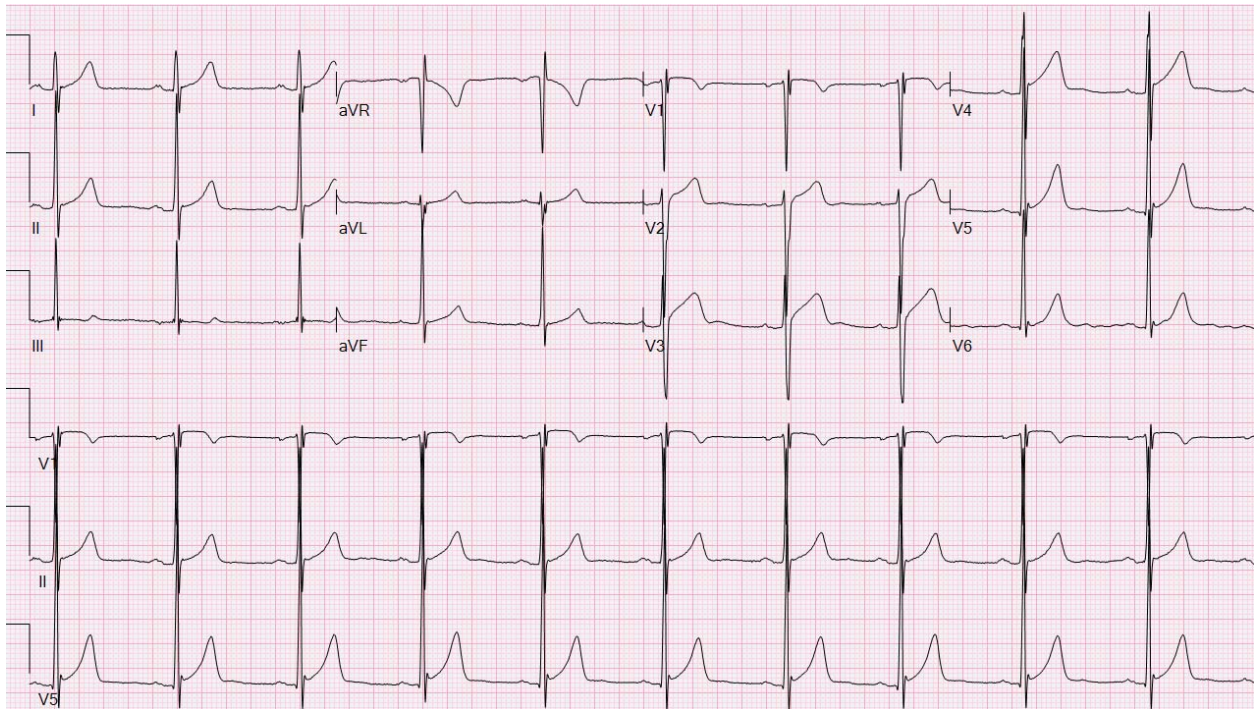


Figure 5: a. Sinus rhythm with PR depression in I, II, V2-V6 and PR elevation in aVR. There is a prominent notch at the end of the QRS in leads V2-V6. In addition, there is ST elevation in I, II, aVL, V2-V6 and ST depression in aVR. The ST/T ratio in V5 is 0.3. Previous ECGs (**b.** and **c.**) show atrial fibrillation without prominent QRS notch or ST deviation.

