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ST-elevation in lead aVR: Is it an emergency?

Anand Reddy Maligireddy, Muiz Khan Tareen*, Sahithi Sharma, Haseeb Khan Tareen, Minako Katayama and Hari P. Chaliki

Mayo Clinic, Department of Cardiovascular Medicine, Scottsdale, Arizona, USA

***Corresponding Author:**
Muiz Khan Tareen
Mayo Clinic, Department of Cardiovascular Medicine, Scottsdale, Arizona, USA

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1. Abstract

A 63-year-old male with moderate to severe aortic stenosis (AS) underwent a treadmill exercise test as part of his evaluation, which revealed ST-segment elevation of more than 5 mm in leads aVR and V1. This finding is typically associated with significant stenosis of the left main coronary artery (LMCA) or proximal left anterior descending artery (LAD). However, the patient's emergent cardiac catheterization showed only a 20% lesion in both the LMCA and LAD, with a total occlusion of the right coronary artery (RCA). This case highlights a unique scenario where moderate-severe aortic stenosis, in combination with chronic total occlusion of the RCA, leads to ST-segment elevation in lead aVR, despite the absence of significant stenosis in the proximal left coronary arteries. This case emphasizes that aortic stenosis, particularly when accompanied by chronic occlusion of the RCA, can cause changes in the electrocardiogram that are typically linked to left coronary artery disease, helping clinicians understand the broader range of causes behind aVR ST-segment elevation.

2. Background

Diffuse ST-segment depression with ST-segment elevation in lead aVR is traditionally associated with stenosis of either LMCA or proximal LAD, which is associated with higher 30-day mortality[1,2]. A wide-ranging of other etiologies such as acute pulmonary embolism, severe anemia, tachyarrhythmia, coronary vasospasms and takotsubo cardiomyopathy may present as ST-segment elevation in lead aVR [3-5].

3. Objective

To describe aVR ST-Elevation caused by aortic stenosis with single vessel chronic RCA occlusion.

4. Case Report

A 63-year-old male presented for routine evaluation of known AS with atypical chest symptoms. The cardiovascular examination was significant for late peaking systolic murmur best heard at the right upper sternal border and diminished second heart sound. Past medical history was significant for aortic valve (AV) disease, hyperlipidemia, and smoking.

Transthoracic echocardiogram revealed moderate to severe calcific AS and mild−moderate aortic regurgitation with AV area of 1.32 cm^2 and AV mean gradient of 35 mmHg and normal left ventricular ejection fraction (Figure: 1, Video:1).

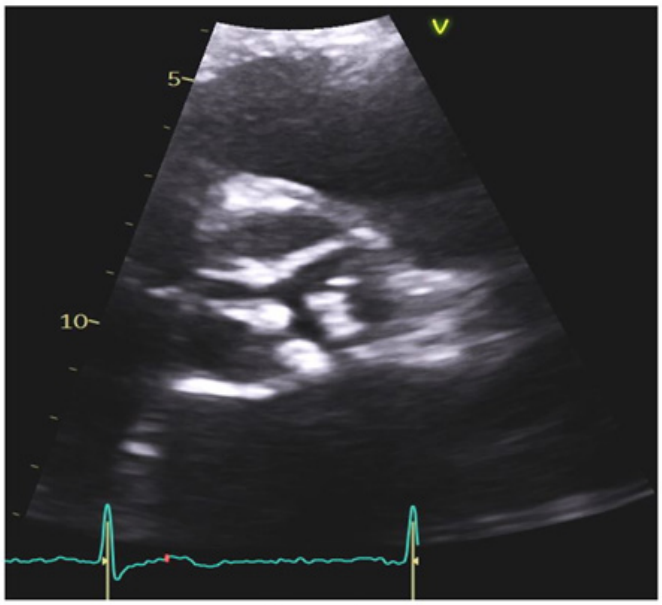

Figure 1: Transthoracic echocardiography showing aortic valve in parasternal short axis view.

The next day, treadmill stress ECG test was performed to evaluate atypical chest symptoms using Bruce protocol. The patient exercised for 8.53 minutes achieving 98% predicted functional aerobic capacity. Peak blood pressure and heart rate were 197/77 mmHg and 142 beats per minute, respectively. The test revealed ST-segment elevation of > 5mm in aVR lead and V1 lead with multi lead ST-segment depression during the stress test (Figure: 2). The test was terminated due to significant ST-segment changes. The patient did not have any symptoms during the test.

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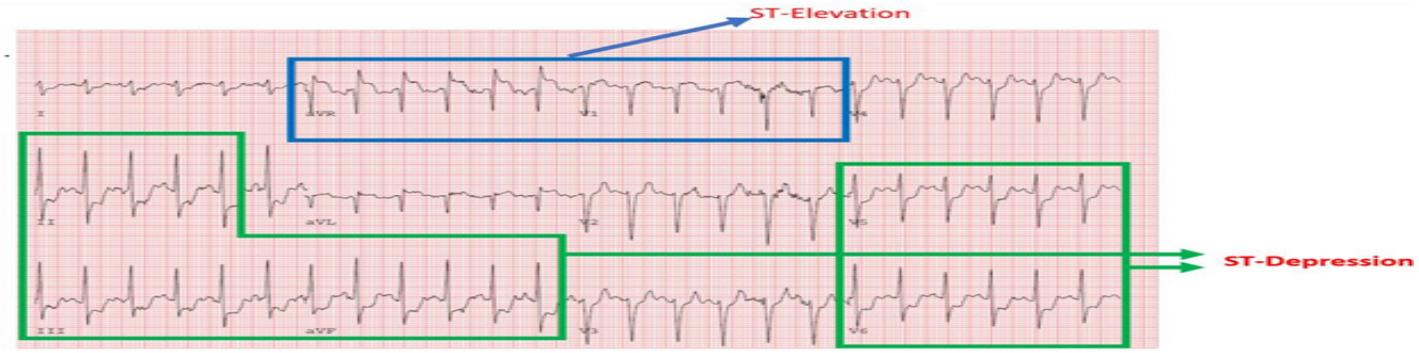

Figure 2: Treadmill Exercise stress test ECG showing ST-segment elevation of >5mm in aVR lead and V1 lead with ST-depression in inferior-lateral leads during the peak phase

The ST elevation in aVR lead to raised concern for left main disease and the patient underwent emergent cardiac catheterization. The emergent cardiac catheterization demonstrated 20% discrete lesion of both LMCA and LAD with total occlusion of right coronary artery (RCA). This was also confirmed by Fractional flow reserve (FFR) (Figure: 3, Video: 2).

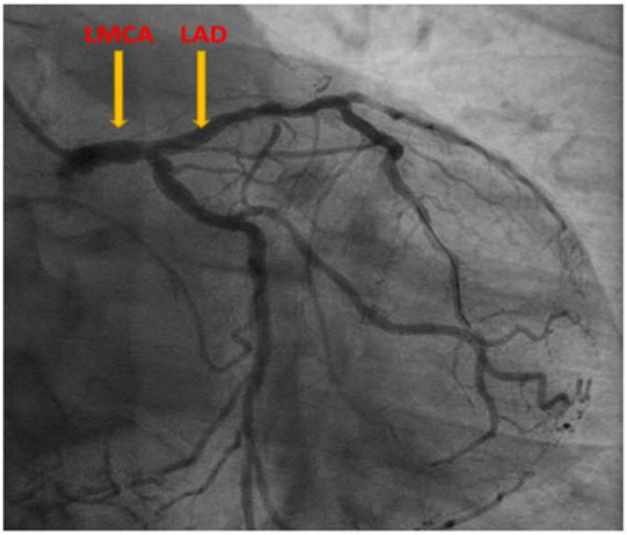

Figure 3: Cardiac catheterization demonstrating 20% discrete lesion of both LMCA and LAD.

Despite absence of symptoms, given marked ECG changes, the patient underwent AV replacement without coronary artery bypass grafting (CABG). Follow-up stress ECG four months after surgery didn't show any ischemic findings.

5. Discussion

Frequently, ST-elevation in lead aVR is associated with stenosis of either LMCA or proximal LAD and higher 30-day mortality [1, 2]. The lead aVR due to its unique alignment, allows it to record electrical activity from the right upper portion of heart, including the basal ventricular septum and right ventricular outflow tract. The basal ventricular septum is supplied by the proximal LAD through first septal perforator artery, so infarction of this region would indicate involvement of the either LMCA or proximal LAD [6].

Exercise ECG testing in patients with significant AS not infrequently can cause ST segment depression due to left ventricular hypertrophy. But ST-elevation is not common [7]. We present an unusual case with moderately severe AS with single vessel RCA disease who showed ST-elevation in lead aVR during the stress testing. We thought that stress ECG changes seen in this patient could have been due to global left ventricular ischemia in the setting of moderate-severe AS with RCA occlusion. This was supported by the negative stress ECG test performed four months after the valve replacement surgery without CABG.

This case report will help clinicians to understand how AS can cause aVR ST-segment elevation without significant stenosis of proximal left coronary arteries.

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