CLINICAL VIGNETTE

Dynamic ST-Segment Elevation Mimicking Acute Myocardial Infarction in a Patient with Chest Pain and Acute COVID-19 Infection

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Introduction

Since December 2019, the world-wide outbreak of the Coronavirus disease 2019 (COVID-19) has led to illnesses ranging from mild to critical.[1] Patients with pre-existing cardiovascular conditions have worse outcomes and mortality with COVID-19. Patients without prior cardiovascular disease can also present with significant cardiac complications.[2] The electrocardiogram (ECG) is one of the most common tools used to assess for cardiovascular involvement for patients and the ECG abnormalities associated with COVID-19 infections are important to identify. This patient with acute COVID-19 infection had significant ECG abnormalities which mimicked an acute myocardial infarction.

Case Report

A 67-year-old male with dyslipidemia and a family history of coronary artery disease arrived to the emergency room after a syncopal episode with sudden, complete loss of consciousness followed by persistent left sided chest pain graded 6/10 that had lasted the entire day. The patient recently flew in from New Jersey to visit family in California. He developed intermittent coughing and tested positive for COVID-19 prior to arrival to the hospital. He was afebrile and hypertensive with a systolic blood pressure in the 140 to 150's. His ECG was abnormal with subtle ST-elevation in V1-2 and very prominent >3mm ST elevation in V3 (Figure 1). He continued to have chest pain in the ER and developed dynamic worsening ST-elevation in the anteroseptal leads V1-3 (Figure 2) and was thus emergently transferred to the cardiac catheterization laboratory for a coronary angiogram. The patient had received aspirin 325mg, sublingual nitroglycerin, and a heparin 5000 Unit IV bolus in the ER. The coronary angiogram did not reveal any evidence of obstructive coronary artery disease with only mild non-obstructive atherosclerosis (Figure 3). Echocardiogram revealed no evidence of any structural heart disease or any pericardial effusion with normal left ventricular systolic function. Labs included a mildly elevated ESR and CRP levels but no elevation of CK levels or troponins during his hospitalization. He had frequent premature ventricular contractions on telemetry without any significant sustained arrhythmias and was continued on aspirin and started on a beta blocker and statin. The patient did not develop any significant worsening of respiratory symptoms and was treated with empirical dexamethasone and colchicine. Serial ECG's showed improvement in ST-elevation (Figure 4) along the anteroseptal leads. He was discharged from the hospital with clinical improvement and resolution of chest pain.

Discussion

The ECG abnormalities in COVID-19 have been thought to result from multiple mechanisms including cytokine storm, hypoxic injury, electrolyte abnormalities, plaque rupture, coronary spasm, hypercoagulability and microthrombi, or direct endothelial and myocardial injury.[3] A reviewed characterized myocardial injury in patients with COVID-19 infections and summarized the ECG abnormalities including supraventricular tachycardias (atrial fibrillation or flutter), ventricular arrhythmias (ventricular tachycardia or fibrillation), ST- elevation and depression (regional or diffuse), T-wave inversion, q-waves, low voltage, conduction disturbances (bradycardia and atrioventricular block), and interval/axis abnormalities.[4] ST-elevation on ECG triggers rapid clinical assessment due to the concern for possible acute myocardial infarction when patients present. A case series reported ST-elevation in the setting of COVID-19 has variable presentations with a high prevalence of non-obstructive coronary disease despite a continued poor prognosis.[5] An Italian study followed COVID-19 patients with ST-elevation on ECG suspected of acute myocardial infarction who had coronary angiograms. Nearly 40% did not have any evidence of obstructive coronary artery disease.[6] These studies reveal the diagnostic challenges that physicians face interpreting ECG's in patients with acute COVID-19 infections. Balancing safety in preventing spread of infections to healthcare workers when performing invasive procedures and optimizing treatments to minimize cardiovascular complications. This dilemma has led to protocols to avoid invasive cardiac procedures and resort to fibrinolysis as an upfront strategy for patients with ST-elevation on ECG in the setting of COVID-19 infections. Others have argued that since a significant portion of these patients may not require reperfusion, this strategy could cause more harm than benefit.[7] In the US, experts consensus supports careful weighing of healthcare provider exposure and patient benefit on a case-by-case basis when deciding to perform invasive cardiac procedures if ST-elevation is noted on ECG in the setting of acute COVID-19.[8]

Conclusion

This patient with acute COVID-19 with ECG abnormalities with ST-elevation mimicking an acute myocardial infarction but had no evidence of any acute myocardial damage based on cardiac enzymes and echocardiography or any obstructive disease on angiography. It is important to recognize the different ECG abnormalities that can result from an acute COVID-19 infection and carefully weigh the risks and benefits of treatment strategies when caring for this patient population.

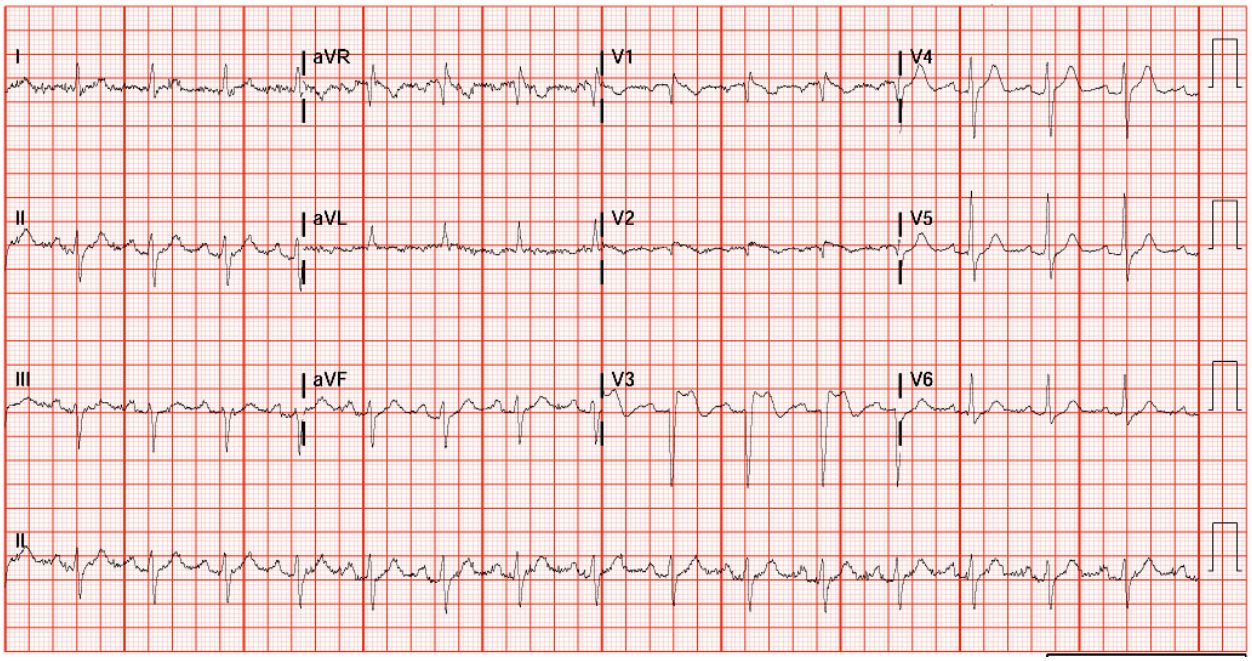

Figure 1: ECG revealing ST elevation in anteroseptal leads V1-3.

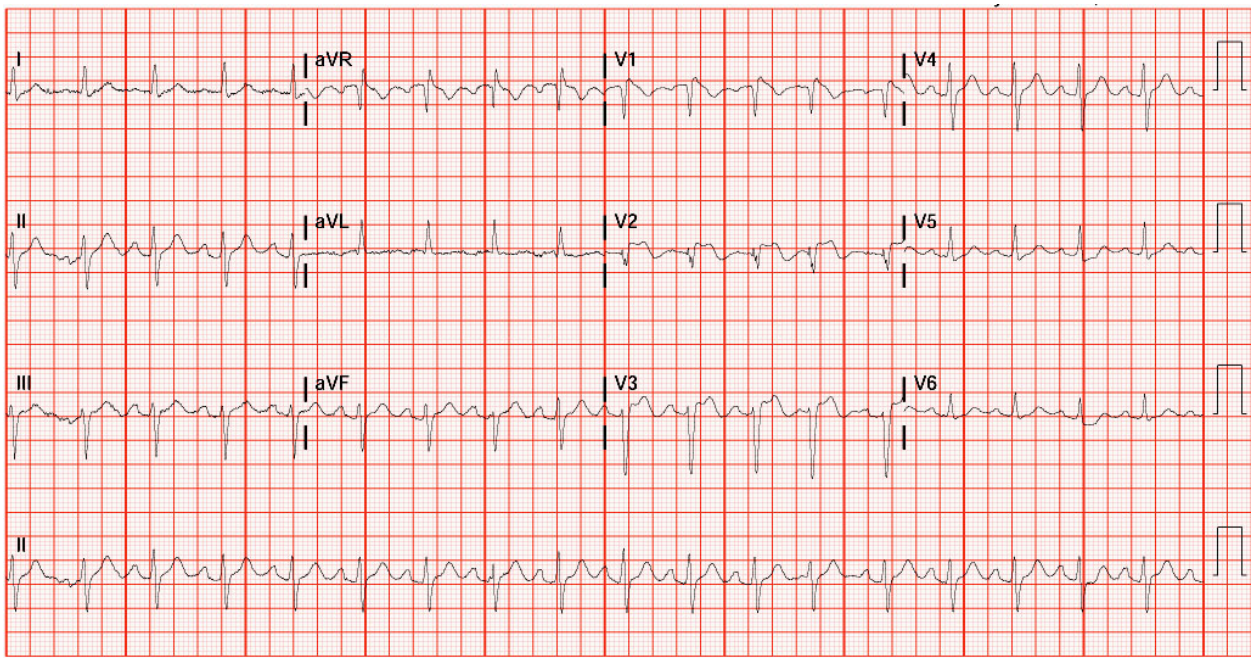

Figure 2: Serial ECG revealing ST elevation worsening in anteroseptal leads V1-3.

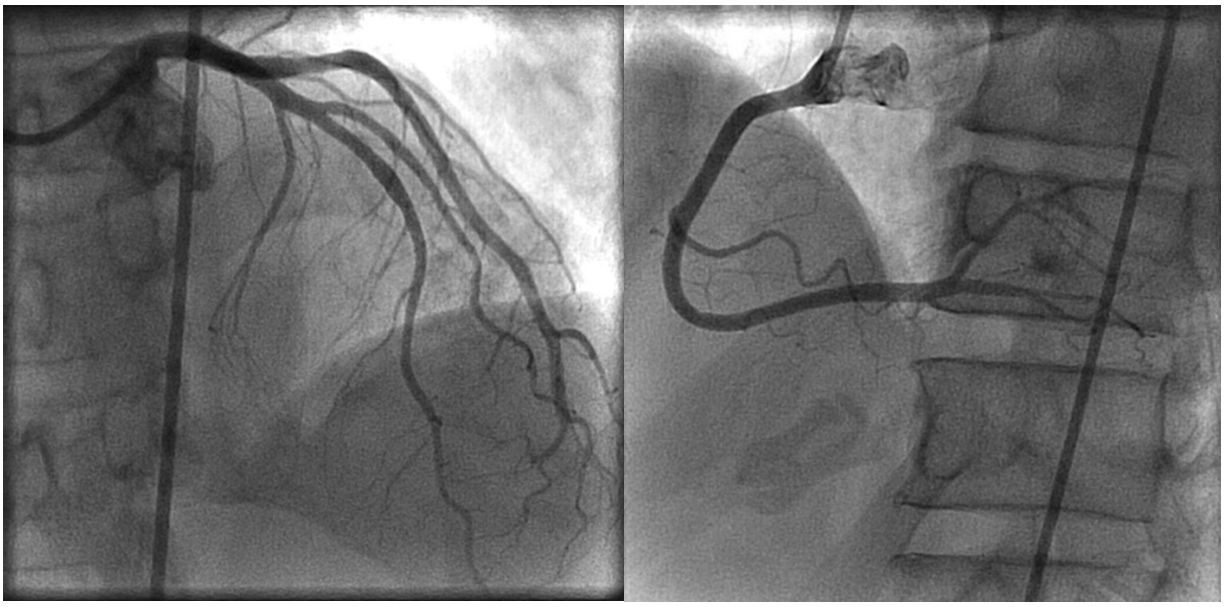

Figure 3: Coronary angiogram of left and right coronary systems with no obstructive coronary disease along epicardial vessels.

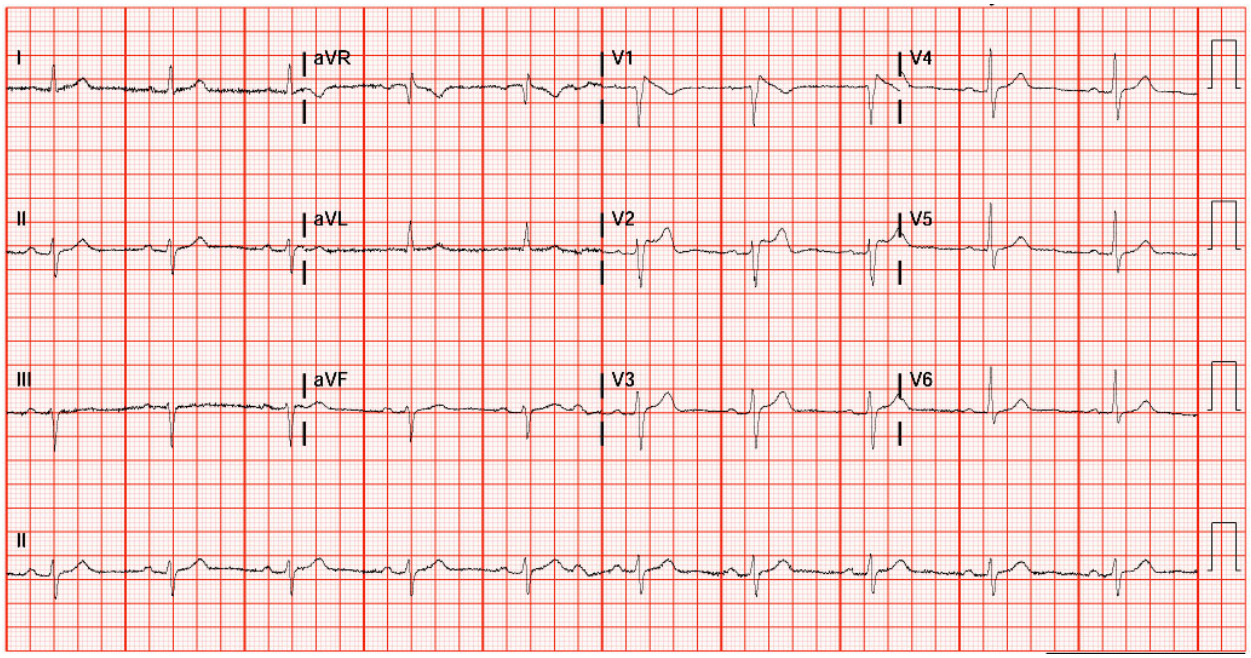

Figure 4: ECG revealing improvement in ST elevation along anteroseptal leads V1-3 with marked change in lead V3 from initial tracings.

REFERENCES

1. **Wu Z, McGoogan JM**. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. *JAMA*. 2020 Apr 7;323(13):1239-1242. doi: 10.1001/jama.2020.2648. PMID: 32091533.
2. **Nishiga M, Wang DW, Han Y, Lewis DB, Wu JC**. COVID-19 and cardiovascular disease: from basic mechanisms to clinical perspectives. *Nat Rev Cardiol*. 2020 Sep; 17(9):543-558. doi: 10.1038/s41569-020-0413-9. Epub 2020 Jul 20. PMID: 32690910; PMCID: PMC7370876.
3. **Long B, Brady WJ, Bridwell RE, Ramzy M, Montrief T, Singh M, Gottlieb M**. Electrocardiographic manifestations of COVID-19. *Am J Emerg Med*. 2020 Dec 29;41:96-103. doi: 10.1016/j.ajem.2020.12.060. Epub ahead of print. PMID: 33412365; PMCID: PMC7771377.
4. **Giustino G, Croft LB, Stefanini GG, Bragato R, Silbiger JJ, Vicenzi M, Danilov T, Kukar N, Shaban N, Kini A, Camaj A, Bienstock SW, Rashed ER, Rahman**

K, Oates CP, Buckley S, Elbaum LS, Arkonac D, Fiter R, Singh R, Li E, Razuk V, Robinson SE, Miller M, Bier B, Donghi V, Pisaniello M, Mantovani R, Pinto G, Rota I, Baggio S, Chiarito M, Fazzari F, Cusmano I, Curzi M, Ro R, Malick W, Kamran M, Kohli-Seth R, Bassily-Marcus AM, Neibart E, Serrao G, Perk G, Mancini D, Reddy VY, Pinney SP, Dangas G, Blasi F, Sharma SK, Mehran R, Condorelli G, Stone GW, Fuster V, Lerakis S, Goldman ME. Characterization of Myocardial Injury in Patients With COVID-19. *J Am Coll Cardiol*. 2020 Nov 3;76(18):2043-2055. doi: 10.1016/j.jacc.2020.08.069. PMID: 33121710; PMCID: PMC7588179.

5. **Bangalore S, Sharma A, Slotwiner A, Yatskar L, Harari R, Shah B, Ibrahim H, Friedman GH, Thompson C, Alviar CL, Chadow HL, Fishman GI, Reynolds HR, Keller N, Hochman JS**. ST-Segment Elevation in Patients with Covid-19 - A Case Series. *N Engl J Med*. 2020 Jun 18;382(25):2478-2480. doi: 10.1056/NEJMc2009020. Epub 2020 Apr 17. PMID: 32302081; PMCID: PMC7182015.
6. **Stefanini GG, Montorfano M, Trabattoni D, Andreini D, Ferrante G, Ancona M, Metra M, Curello S, Maffeo D, Pero G, Cacucci M, Assanelli E, Bellini B, Russo F, Ielasi A, Tespili M, Danzi GB, Vandoni P, Bollati M, Barbieri L, Oreglia J, Lettieri C, Cremonesi A, Carugo S, Reimers B, Condorelli G, Chieffo A**. ST- Elevation Myocardial Infarction in Patients With COVID-19: Clinical and Angiographic Outcomes. *Circulation*. 2020 Jun 23;141(25):2113-2116. doi: 10.1161/CIRCULATIONAHA.120.047525. Epub 2020 Apr 30. PMID: 32352306; PMCID: PMC7302062.
7. **Zeng J, Huang J, Pan L**. How to balance acute myocardial infarction and COVID-19: the protocols from Sichuan Provincial People's Hospital. *Intensive Care Med*. 2020 Jun;46(6):1111-1113. doi: 10.1007/s00134-020-05993-9. Epub 2020 Mar 11. PMID: 32162032; PMCID: PMC7079823.
8. **Welt FGP, Shah PB, Aronow HD, Bortnick AE, Henry TD, Sherwood MW, Young MN, Davidson LJ, Kadavath S, Mahmud E, Kirtane AJ; American College of Cardiology's Interventional Council and the Society for Cardiovascular Angiography and Interventions**. Catheterization Laboratory Considerations During the Coronavirus (COVID-19) Pandemic: From the ACC's Interventional Council and SCAI. *J Am Coll Cardiol*. 2020 May 12;75(18):2372-2375. doi: 10.1016/j.jacc.2020.03.021. Epub 2020 Mar 19. PMID: 32199938; PMCID: PMC7270593.