

Multiple spontaneous coronary thrombosis causing ST-elevation myocardial infarction in a patient with COVID-19

Hibba Kurdi¹

Daniel R Obaid¹

Zia UIHaq¹

Adrian Ionescu¹

Baskar Sekar¹

Correspondence to:
Hibba Kurdi; hibba.kurdi@doctors.org.uk

Introduction

Managing acute coronary syndromes in the COVID-19 era can be difficult because of the lack of rapid, accurate diagnostic tests to inform infection control and respiratory management. In addition, aetiology of acute coronary syndromes in patients with COVID-19 is variable, requiring an individualised approach to long-term therapy.

Case report

A 54-year-old man presented with ischaemic chest pain and dyspnoea on day 13 of self-isolation for suspected COVID-19. His wife had returned from New York City 48 hours before the onset of his symptoms of dry cough, pyrexia, myalgia and shortness of breath. He was diaphoretic, tachypnoeic on admission and required high flow oxygen 15 litres/min to maintain saturations $\geq 94\%$. He was obese (body mass index 36 kg/m^2) but there were no other cardiac risk factors or history of respiratory diagnoses. Admission chest radiograph revealed bilateral patchy infiltrates highly suspicious of viral COVID-19-associated pneumonia (**Figure 1**). A 12-lead electrocardiogram demonstrated infero-lateral ST elevation (**Appendix Figure A1**). He was transferred to the authors' designated COVID-19 lab for primary percutaneous coronary intervention with all staff using appropriate personal protective equipment for droplet and contact precautions.

Coronary angiography revealed a large occlusive thrombus in the right coronary artery (**Figure 2a**) and a smaller filling defect in the mid left anterior descending coronary artery, also suspicious of thrombus (**Figure 2b**). The right coronary artery was treated first, but despite multiple attempts to aspirate thrombus and intra-coronary glycoprotein IIb/IIIa inhibitor (tirofiban), only Thrombolysis in Myocardial Infarction (TIMI) grade II flow was achieved, indicating partial reperfusion. The underlying artery appeared free of stenotic disease and there was no angiographic evidence of plaque rupture (**Figure 2c**). The left anterior descending coronary artery was treated with insertion of a drug-eluting intra-coronary stent (**Figure 2d**).

Post-procedure the patient was transferred to the COVID coronary care unit. In view of the significant thrombus burden, intravenous tirofiban and low molecular weight heparin (Clexane) was continued for 48 hours, followed by a direct oral anticoagulant (rivaroxaban), continued lifelong, in addition to dual antiplatelet therapy (aspirin lifelong and clopidogrel for 12 months). A transthoracic echocardiogram revealed regional wall motion abnormalities consistent with infarcts in the right coronary artery and left anterior descending coronary artery territory, with mildly impaired left ventricular systolic function (ejection fraction estimated at 45%). Blood test results are shown in **Appendix Table A1**.

Although stable initially, his oxygen requirement continued to increase. Initial pharyngeal swab reverse-transcriptase polymerase chain reaction for severe acute respiratory syndrome coronavirus 2 taken before primary percutaneous coronary intervention was negative. No other respiratory pathogens were isolated from pharyngeal swabs, blood or sputum, and given the high clinical suspicion and chest radiograph appearance, a computed tomography scan of the thorax was performed because of its increased diagnostic yield to detect COVID infection compared to reverse-transcriptase polymerase chain reaction (sensitivity 98% vs 71% respectively, $P < 0.001$) (Fang et al, 2020). This revealed bilateral ground-glass changes with a peripheral distribution consistent with the late or 'recovery' phase of COVID-19 pneumonia (**Figure 3**). The computed tomography findings are not exclusive to COVID-19 patients, but the clinical presentation makes COVID-19 the most probable diagnosis. The patient improved with supportive therapy, did not require intubation and invasive ventilation, and was discharged to his own home on day 15 of his hospital stay. He remains well at 8-week virtual clinic follow up.

How to cite this article:

Kurdi H, Obaid DR, UIHaq Z, Ionescu A, Sekar B. Multiple spontaneous coronary thrombosis causing ST-elevation myocardial infarction in a patient with COVID-19. *Br J Hosp Med.* 2020. <https://doi.org/10.12968/hmed.2020.0337>

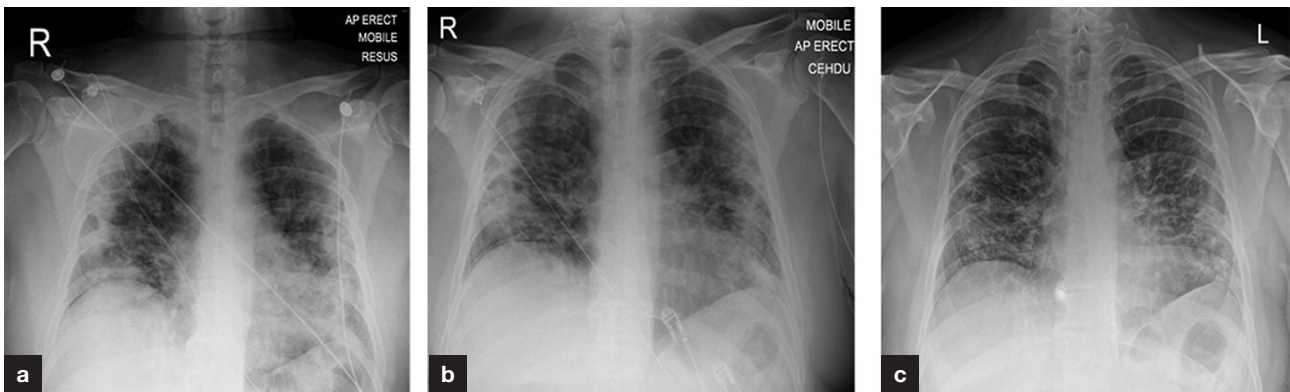


Figure 1. a. Admission chest X-ray demonstrating patchy peripheral air space opacification typically associated with COVID-19. b. Day 3 and (c) day 12 demonstrating persisting changes.

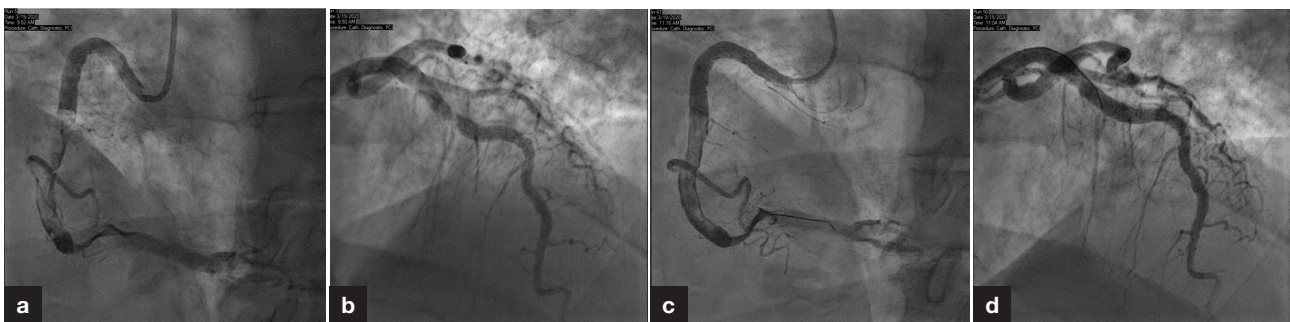


Figure 2. Coronary angiogram showing (a) heavy thrombotic burden of the mid right coronary artery, (b) severe stenosis in the mid left anterior descending artery, (c) Thrombolysis in Myocardial Infarction II flow of the right coronary artery at the end of the procedure, indicating partial re-perfusion of the vessel and (d) good angiographic result post primary coronary intervention and stent to the mid left anterior descending artery. Video clips can be found in the appendix.



Figure 3. Computed tomography images of the chest from day 13 of admission demonstrating (a) multiple bilateral lobular and sub segmental areas (arrows) of ground-glass opacities and consolidation, (b) reverse halo sign (arrow) which is an area of central ground-glass opacification surrounded by denser consolidation, (c) bilateral reticular pattern superimposed on widespread ground-glass opacification referred to as ‘crazy paving pattern.’

This article presents a 54-year-old Caucasian man diagnosed with infero-lateral ST elevation myocardial infarction amid his COVID-19 illness. Angiography revealed thrombus in the right coronary artery and a smaller lesion in the mid left anterior descending artery. Lesions were treated with a combination of thrombus aspiration, intra-coronary glycoprotein IIb–IIIa inhibitor (tirofiban) and drug-eluting stent with good results. Dual antiplatelet therapy and direct oral anticoagulant were initiated post procedure. After multiple negative reverse-transcriptase polymerase chain reaction (pharyngeal and sputum) results, despite high clinical suspicion, a computed tomography scan of the thorax confirmed findings consistent with the probable recovery phase of COVID-19 pneumonia.

Learning points

- The aetiology of acute coronary syndromes in patients with COVID-19 is highly variable, and is a combination of obstructive and non-obstructive coronary artery disease.
- The highly thrombotic nature of SARS-CoV-2 infection is hypothesised to be the result of effects of a cytokine storm. It is unclear how long after the illness this prothrombotic state exists, so an individualised approach to dual antiplatelet therapy and anticoagulation is advised.
- Computed tomography of the thorax has superior sensitivity over reverse-transcriptase polymerase chain reaction in late presenting cases, and early use should be considered in conjunction with British Society of Thoracic Imaging guidelines.

Discussion

COVID-19 and other coronavirus infections have been associated with cardiovascular complications as a result of the pro-inflammatory response and potential for vascular endothelial damage which can result in myocarditis, plaque rupture and arrhythmia (Xiong et al, 2020). COVID-19 infection is also now increasingly associated with predisposition to both venous and arterial thrombosis (Bikdeli et al, 2020). Coronary angiography performed in patients with ST elevation and COVID-19 has revealed a mixture of both obstructive and non-obstructive plaque (Bangalore et al, 2020). This article presents a report of apparent spontaneous thrombosis simultaneously in multiple coronary arteries in the absence of discernible coronary plaque, demonstrating a potential complication of the pro-thrombotic tendency in COVID-19.

There is a well-documented increase in the risk of acute coronary syndrome in the context of acute respiratory infections (Thachil, 2020). In other pneumonia-like illnesses this highly thrombotic state has been found to increase the future risk of cardiovascular disease even at 10-year follow up, as reinforced by Xiong et al (2020) and Corrales-Medina et al (2015). This patient presented at the early stages of the pandemic and therefore a D-dimer level was not checked as is now routine in most centres. However, in a previous study, up to 64% of patients with ST-segment elevation myocardial infarction had a normal D-dimer level (Choi et al, 2016), so this is unlikely to have changed the management significantly.

In addition, a high index of suspicion should remain for COVID-19 despite negative reverse-transcriptase polymerase chain reaction results if the clinical picture is suggestive, given implications for hospital infection control policies and, potentially, for long-term follow up (Watson et al, 2020). Early computed tomography thorax should be considered where the pre-test probability of COVID-19 remains high. The British Society of Thoracic Imaging (2020) has published a decision tool with regards to use of computed tomography scanning in patients with suspected COVID-19.

Author details

¹Morrison Cardiology Centre, Morrison Hospital, Swansea, UK

References

- Bangalore S, Sharma A, Slotwiner A et al. ST-segment elevation in patients with Covid-19: a case series. *N Engl J Med*. 2020;382(25):2478–2480. <https://doi.org/10.1056/NEJMc2009020>
- Bikdeli B, Madhavan MV, Jimenez D et al. COVID-19 and thrombotic or thromboembolic disease: implications for prevention, antithrombotic therapy, and follow-up. *J Am Coll Cardiol*. 2020;75(23):2950–2973. <https://doi.org/10.1016/j.jacc.2020.04.031>
- British Society of Thoracic Imaging. Radiology decision tool for suspected COVID-19. 2020. https://www.bsti.org.uk/media/resources/files/NHSE_BSTI_APPROVED_Radiology_on_CoVid19_v6_ucQtNv.pdf (accessed 24 June 2020)

- Choi S, Jang WJ, Song YB et al. D-dimer levels predict myocardial injury in ST-segment elevation myocardial infarction: a cardiac magnetic resonance imaging study. *PLoS One*. 2016;11(8):e0160955–e0160955. <https://doi.org/10.1371/journal.pone.0160955>
- Corrales-Medina VF, Alvarez KN, Weissfeld LA et al. Association between hospitalization for pneumonia and subsequent risk of cardiovascular disease. *JAMA*. 2015;313(3):264–274. <https://doi.org/10.1001/jama.2014.18229>
- Fang Y, Zhang H, Xie J et al. Sensitivity of chest CT for COVID-19: comparison to RT-PCR. *Radiology*. 2020;19:200432. <https://doi.org/10.1016/j.crad.2020.03.008>
- Thachil J. The versatile heparin in COVID-19. *J Thromb Haemost*. 2020;18(5):1020–1847. <https://doi.org/10.1111/jth.14821>
- Watson J, Whiting PF, Brush JE. Interpreting a COVID-19 test result. *BMJ*. 2020;369:m1808. <https://doi.org/10.1136/bmj.m1808>
- Xiong TY, Redwood S, Prendergast B, Chen M. Coronaviruses and the cardiovascular system: acute and long-term implications. *Eur Heart J*. 2020;41(19):1798–1800. <https://doi.org/10.1093/eurheartj/>

Appendix

Table A1. Biochemistry and haematology results during admission				
	Day 0 (first day of hospital admission)	Day 3 (intensive therapy unit)	Day 15 (last day)	Normal laboratory values
White blood cell count	13.6x10 ⁹ /litre	17.9x10 ⁹ /litre	11.9x10 ⁹ /litre	4.0–11x10 ⁹ /litre
Haemoglobin	151 g/litre	119 g/litre	100 g/litre	130–180 g/litre
Mean corpuscular volume	88 f/litre	91 f/litre	95 f/litre	80–100 f/litre
Platelet count	508x10 ⁹ /litre	486x10 ⁹ /litre	542x10 ⁹ /litre	150–400x10 ⁹ /litre
Neutrophil count	10.9x10 ⁹ /litre	15.3x10 ⁹ /litre	7.6x10 ⁹ /litre	1.7–7.5x10 ⁹ /litre
Lymphocyte count	1.5x10 ⁹ /litre	1.0x10 ⁹ /litre	2.4x10 ⁹ /litre	1.0–4.5x10 ⁹ /litre
Monocyte count	1.0x10 ⁹ /litre	1.5x10 ⁹ /litre	0.8x10 ⁹ /litre	0.2–0.8x10 ⁹ /litre
C-reactive protein	117 mg/litre	87 mg/litre	8 mg/litre	<5 mg/litre
Sodium	141 mmol/litre	140 mmol/litre	136 mmol/litre	133–146 mmol/litre
Potassium	4.0 mmol/litre	3.7 mmol/litre	4.7 mmol/litre	3.5–5.3 mmol/litre
Urea	8.4 mmol/litre	10.4 mmol/litre	4.7 mmol/litre	2.5–7.8 mmol/litre
Creatinine	93 umol/litre	78 umol/litre	101 umol/litre	58–110 umol/litre
Estimated glomerular filtration rate	74 ml/min/1.73 m ²	79 ml/min/1.73 m ²	67 ml/min/1.73 m ²	>60 ml/min/1.73 m ²
Bilirubin	18 umol/litre	26 umol/litre	11 umol/litre	<21 umol/litre
Albumin	30 g/litre	29 g/litre	31 g/litre	35–50 g/litre
Alanine transaminase	41 U/litre	85 U/litre	184 U/litre	<41 U/litre
Alkaline phosphatase	66 U/litre	50 U/litre	91 U/litre	30–130 U/litre
Lactate	2.3 mmol/litre	1.3 mmol/litre	Not tested	0.5–1.6 mmol/litre
N-terminal pro B-type natriuretic peptide	166 ng/litre	Not repeated	Not repeated	>300 ng/litre suggestive of acute heart failure
High sensitivity troponin T	97 ng/litre	4582 ng/litre	324 ng/litre	<14 ng/litre
Prothrombin time	Not tested	22.6 seconds	Not tested	9.0–12.5 seconds
Activated partial thromboplastin time	Not tested	27.1 seconds	Not tested	22.1–30.9 seconds
Clauss fibrinogen level	Not tested	4.4 g/litre	Not tested	2.0–4.0 g/litre
Ferritin	Not tested	Not tested	2584 ug/litre	15–300 ug/litre
Folate	Not tested	Not tested	<2.0 ug/litre	>3.0 ug/litre
Serum iron	Not tested	Not tested	11 umol/litre	10–30 umol/litre
Transferrin	Not tested	Not tested	1.7 g/litre	2.0–4.0 g/litre
Transferrin saturation	Not tested	Not tested	25.8%	20.0–50.0%

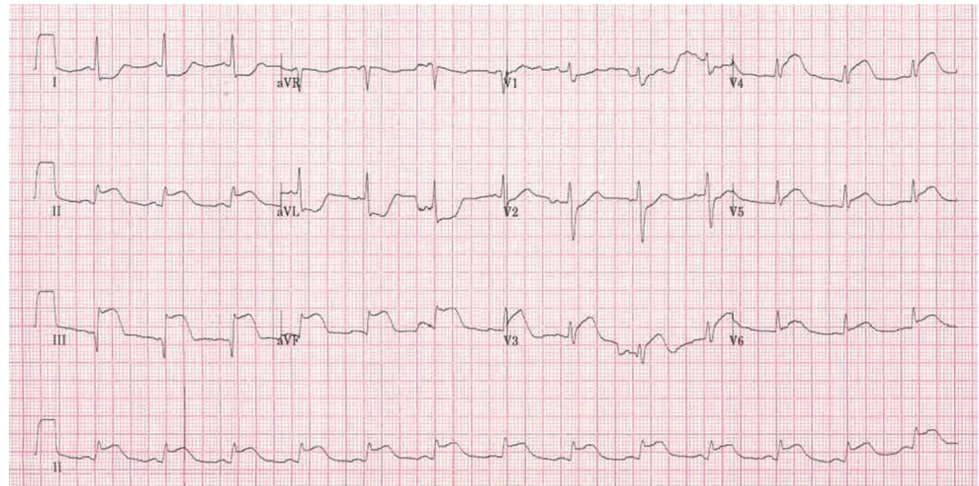


Figure A1. A 12-lead electrocardiogram from admission depicting ST segment elevation in the infero-lateral leads: II, III, aVF, V3-V6.

Figure A2. Video [Supplemental file 1_Mid LAD stenosis.avi] of the coronary angiogram illustrating the mid left anterior descending artery stenosis.

Figure A3. Video [Supplemental file 2_Mid LAD stented.avi] of the coronary angiogram showing the mid left anterior descending lesion post stent with successful return of blood flow.

Figure A4. Video [Supplementary file 3_RCA.avi] of the coronary angiogram illustrating the large occlusive thrombus of the right coronary artery.

Figure A5. Video [Supplemental file 4_RCA TIMI 2 flow.avi] of the coronary angiogram showing the right coronary artery thrombus after multiple attempts to aspirate the thrombus with only partial restoration of blood flow (Thrombolysis in Myocardial Infarction score of II).