Received: 3 August 2021 | Revised: 2 November 2021 | Accepted: 5 January 2022

DOI: 10.1002/ccd.30084

CASE REPORT

WILEY

Heavy lone coronary artery thrombosis treated by stent retriever, in the setting of COVID-19 infection

Elias B. Hanna MD[1] | James Rossen MD[2] | Alicia S. Eustes PhD[3] | Sanjana Dayal PhD[3]

[1]Internal Medicine, Cardiovascular Section, University of Iowa Medical Center, Iowa City, Iowa, USA

[2]Internal Medicine, Cardiovascular Section, University of Iowa Hospital, Iowa City, Iowa, USA

[3]Section of Hematology, Oncology, and Blood and Marrow Transplantation, University of Iowa Hospital, Iowa City, Iowa, USA

Correspondence

Elias B. Hanna, MD, Internal Medicine, Cardiovascular Section, University of Iowa Medical Center, 200 Hawkins Dr, E 315GH, Iowa City, IA 52242, USA.
Email: elias-hanna@uiowa.edu

Funding information

Department of Veterans Affairs, Grant/Award Number: I01CX001932; Carver College of Medicine; National Institutes of Health, Grant/Award Number: T32 HL007344

Abstract

We present a case of heavy lone coronary thrombosis in the setting of COVID-19 infection. We highlight the special angiographic, ultrasonographic, and histological features of this thrombus, and we describe the application of carotid stent retriever for its removal.

KEYWORDS

COVID-19, myocardial infarction, stent retriever, thrombectomy, thrombosis

1 | INTRODUCTION

COVID-19 infection has been associated with a hypercoagulable state and vascular thrombi,[1–3] but the clinical and histological features of those thrombi in the coronary vasculature are poorly characterized. We present a case that illustrates the technical challenges of coronary intervention in this setting, as well as the specific histological features of these thrombi.

2 | CASE REPORT

A 35-year-old diabetic, obese man develops initially a mild COVID-19 infection. Two weeks later, he presents with 12 h of chest pain and inferior ST-segment elevation (Figure 1). He is hemodynamically stable and afebrile, with a blood pressure of 128/91 mmHg, a pulse of 102 bpm, an O_2 saturation of 99% on ambient air, normal heart sounds, and clear lungs. Transradial coronary angiography reveals a normal left coronary artery; and a large thrombus in the proximal right coronary artery (RCA) with distal embolization into both the posterior descending artery (PDA) and posterolateral branch (PLB) (Figure 2). Intracoronary ultrasound reveals minimal atherosclerosis and suggests lone thrombus, that is, thrombus overlying intact coronary arterial wall (Figure 3). Aspirin, ticagrelor loading dose, intravenous heparin boluses, and intracoronary eptifibatide are administered and aspiration thrombectomy is performed; this fails to significantly improve the thrombus burden and rather leads to more distal embolization. Eptifibatide is then infused for 18 h, after which repeat angiography reveals a persistently large proximal thrombus and unaltered distal emboli (Figure 4).

A decision is thus made to retrieve the proximal and distal thrombi via a neurovascular stent retriever, using a transfemoral 8-French guide

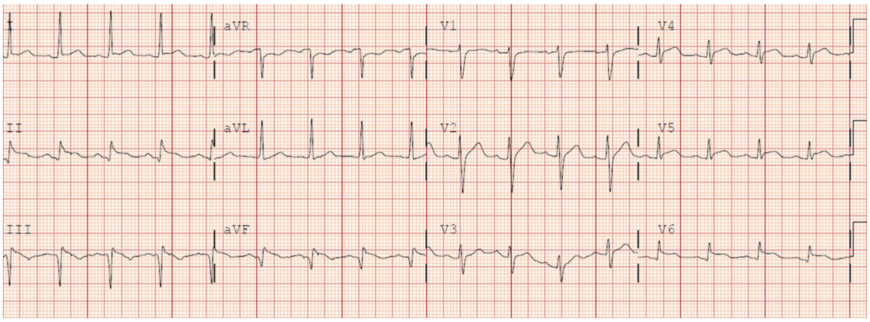

FIGURE 1 ECG on presentation, showing sinus tachycardia and inferior and lateral ST-segment elevation [Color figure can be viewed at wileyonlinelibrary.com]

FIGURE 2 Proximal RCA thrombus extending to the mid-RCA; and distal emboli in both the posterior descending artery and the posterolateral branch, fully interrupting their distal flow (*arrows*). RCA, right coronary artery

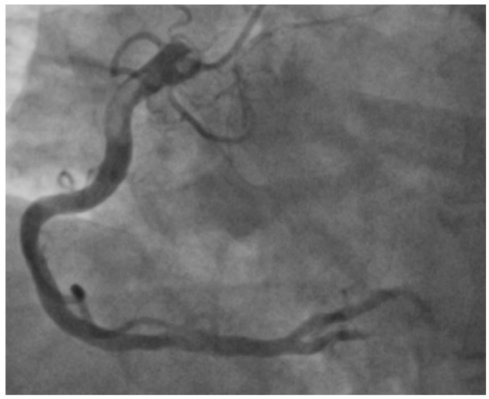

FIGURE 4 Persistent proximal thrombus and distal emboli in both the posterior descending artery and the posterolateral branch despite eptifibatide therapy, with a persistence lack of distal flow

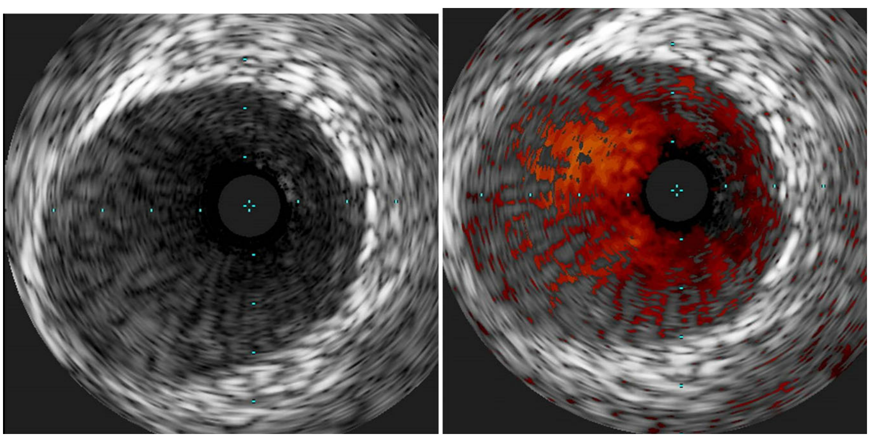

FIGURE 3 Lone thrombus overlying intact coronary arterial wall with no significant plaque [Color figure can be viewed at wileyonlinelibrary.com]

catheter system[1]: a Trevo-Trak microcatheter is advanced over the coronary guidewire into the mid-RCA; the guidewire is withdrawn and a Trevo-NXT 6 × 37 mm stent retriever is advanced across the thrombus and deployed, then slowly withdrawn into the guide catheter, pulling the thrombus that is attached to it (Figures 5 and 6). Complete angiographic resolution of the proximal thrombus is thus achieved.[2] A triaxial system is then advanced into the distal PDA (guidewire, Trevo-Trak microcatheter, and 5-French 125-cm Sophia catheter). A Trevo 3 mm stent retriever is deployed in the thrombus then slowly withdrawn into the 5-French catheter, which is subsequently withdrawn into the guide catheter. Normal distal PDA flow is established (Figures 7 and 8). Left lower lobe pulmonary embolus and multi-lobar pneumonia are additionally

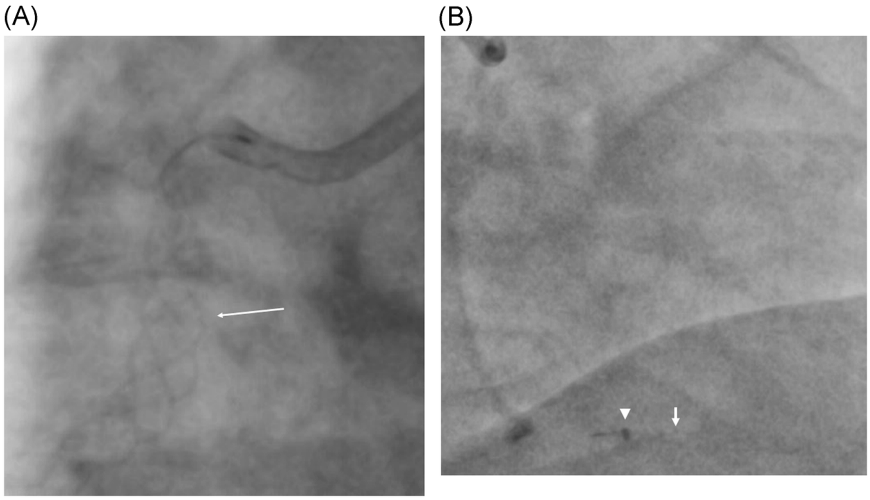

FIGURE 5 (A) Guidewire is pulled back and stent retriever is deployed proximally (*arrow*). (B) Distally, stent retriever is advanced through a 5-French distal catheter (*arrowhead*) and deployed distally in the PDA (*arrow*). PDA, posterior descending artery

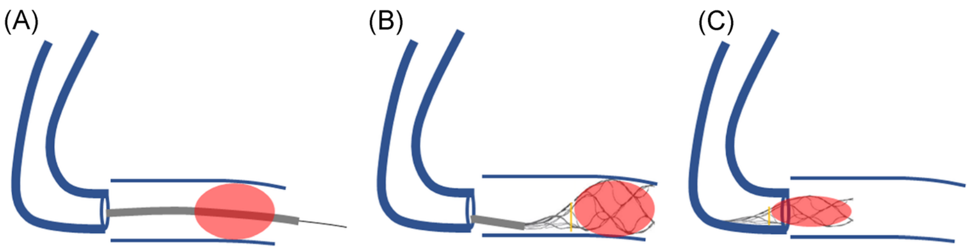

FIGURE 6 Deployment technique of the stent retriever system (available in stent diameters of 3–6 mm). (A) The thrombus is crossed with a guidewire and a microcatheter. (B) The guidewire is removed, and the retrievable stent is advanced inside the microcatheter then unsheathed. (C) After the stent deploys and integrates into the thrombus, the stent and the trapped thrombus are withdrawn into the guide catheter [Color figure can be viewed at wileyonlinelibrary.com]

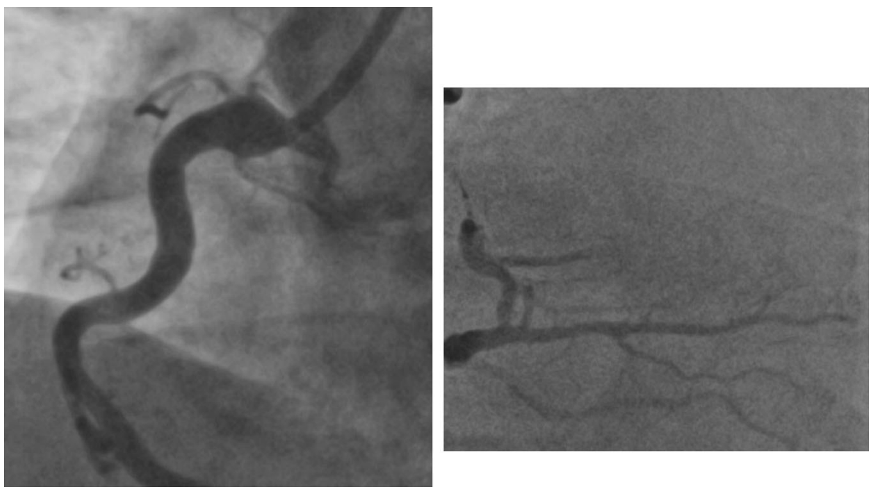

FIGURE 7 Angiographic resolution of proximal RCA and PDA thrombi. PDA, posterior descending artery; RCA, right coronary artery

diagnosed on chest computed tomography. Troponin I peaks at only 0.87 ng/L, and inferior wall hypokinesis resolves 2 months later.

The thrombi are sent for histopathological examination, which reveals the following: a high burden of neutrophil extracellular traps (NETs), but a lack of COVID-19-specific protein (using nucleocapsid antibody stain) (Figure 9).

3 | DISCUSSION

In the coronary system, thrombectomy may be performed using one of the following two traditional techniques: (i) manual aspiration, which is limited by the small caliber of the suction catheters; (ii) or rheolytic thrombectomy (Angiojet), which uses high-pressure saline to create a vacuum at the tip of the catheter, thereby causing both thrombus fragmentation and suction. The stent retriever thrombectomy system has only been studied and approved for use in the intracranial circulation but proved to be essential in our case.[4] It is maneuvered as follows (Figure 6): (i) the thrombus is crossed with a guidewire and a microcatheter, which is positioned distal to the thrombus; (ii) the guidewire is removed, and the stent retriever is advanced inside the microcatheter and unsheathed at the level of the thrombus, allowing it to deploy and integrate into the thrombus; (iii) a stent waist may initially be seen and is followed by progressive stent expansion into the thrombus; (iv) after a short time (typically 2–4 min) of stent-thrombus integration, the stent is withdrawn into the guide, retrieving the thrombus; (v) for a distal thrombus, an intermediate catheter is additionally advanced over the microcatheter and positioned distally, upstream of the thrombus: the stent-thrombus complex is withdrawn into this intermediate catheter, which is then withdrawn into the guide catheter.

COVID-19 infection has been associated with arterial and venous thrombosis. This is likely secondary to systemic inflammation, hypercoagulable state, platelet activation, and diffuse endothelial injury.[1–3] Only one small, 5-patient case series analyzed the histology of coronary thrombi in the COVID-19 setting: a high burden of NETs was found, which is rare and unusual in STEMI patients without COVID-19 infection.[5] NETs are released from activated neutrophils and are rich in prothrombotic factors such as tissue factor, histones and cell-free DNA and have been shown to play a vital role in initiating and perpetuating inflammation and thrombosis in COVID-19.[6] Yet, it remains unclear whether COVID-19 can directly cause coronary thrombosis in a patient with no or minimal atherosclerosis, and whether coronary thrombosis in this setting is more difficult to treat than in non-COVID-19 setting. As such, our case highlights several unique features: (i) lone coronary thrombosis in the setting of COVID-19 infection; (ii) unusual thrombus characteristics: dense, "sticky", totally unresponsive to glycoprotein IIb/IIIa inhibitor therapy, and unusually high in NETs; (iii) applicability of the neurovascular stent retriever in refractory COVID-19-related coronary thrombosis.

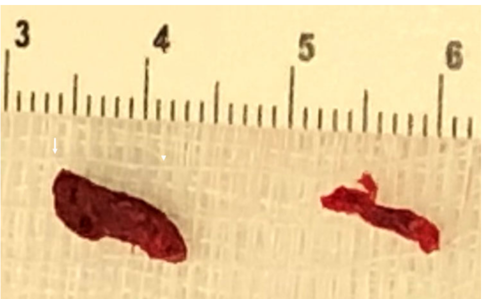

FIGURE 8 Retrieved proximal thrombus (*left*) and distal thrombus (*right*) [Color figure can be viewed at wileyonlinelibrary.com]

4 | CONCLUSION

This case highlights the special angiographic, ultrasonographic, and histological features of lone coronary artery thrombosis in the setting of COVID-19 infection, and the applicability of stent retriever for its removal.

ACKNOWLEDGEMENTS

This work was possible through funding from Department of Veterans Affairs I01CX001932 to S. D., a pilot funding from Carver College of Medicine, UI to S. D., and National Institutes of Health T32 HL007344 to A. S. E.

CONFLICTS OF INTERESTS

The authors declare that there are no conflict of interests.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Elias B. Hanna http://orcid.org/0000-0002-0967-9115

REFERENCES

1. Levi M, Thachil J, Iba T, Levy JH. Coagulation abnormalities and thrombosis in patients with COVID-19. *Lancet Haematol*. 2020;7(6):e438-e440.
2. Bikdeli B, Madhavan MV, Jimenez D, et al. Global COVID-19 Thrombosis Collaborative Group, Endorsed by the ISTH, NATF, ESVM, and the IUA, Supported by the ESC Working Group on

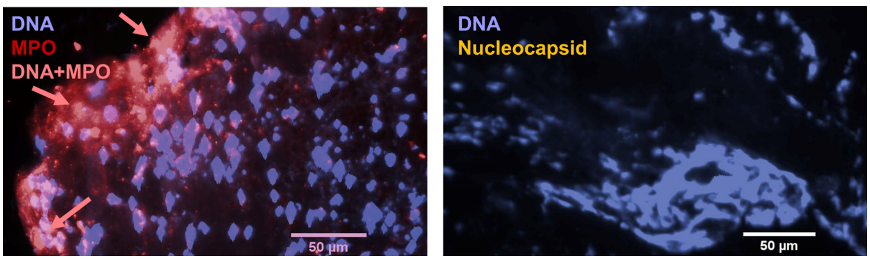

FIGURE 9 Fluorescent thrombus images show positive DNA and myeloperoxidase (MPO) stains, indicating prominent neutrophil extracellular traps, but absent COVID-19 nucleocapsid protein. *Arrows* show double-positive staining for DNA and MPO [Color figure can be viewed at wileyonlinelibrary.com]

Pulmonary Circulation and Right Ventricular Function. COVID-19 and thrombotic or thromboembolic disease: implications for prevention, antithrombotic therapy, and follow-up, JACC state-of-the-art review. *J Am Coll Cardiol*. 2020;75(23):2950-2973.
3. Zhang Y, Xiao M, Zhang S, et al. Coagulopathy and antiphospholipid antibodies in patients with COVID-19. *N Engl J Med*. 2020;382(17):e38.
4. Saver JL, Goyal M, Bonafe A, et al. SWIFT PRIME Investigators. Stent-retriever thrombectomy after intravenous t-PA vs. t-PA alone in stroke. *N Engl J Med*. 2015;372(24):2285-2295.
5. Blasco A, Coronado MJ, Hernández-Terciado F, et al. Assessment of neutrophil extracellular traps in coronary thrombus of a case series of patients with COVID-19 and myocardial infarction. *JAMA Cardiol*. 2020;6(4):1-6.
6. Zuo Y, Estes SK, Ali RA, et al. Prothrombotic autoantibodies in serum from patients hospitalized with COVID-19. *Sci Transl Med*. 2020;12(570):eabd3876.

How to cite this article: Hanna EB, Rossen J, Eustes AS, Dayal S. Heavy lone coronary artery thrombosis treated by stent retriever, in the setting of COVID-19 infection. *Catheter Cardiovasc Interv*. 2022;99:457-461. doi:10.1002/ccd.30084