JACC: CASE REPORTS VOL. 2, NO. 9, 2020

CORONARY INTERVENTIONS

INTERMEDIATE

CASE REPORT: CLINICAL CASE

Feasibility of Prone Position Coronary Angiography in a Patient With COVID-19 Pneumonia and Refractory Hypoxemia

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ABSTRACT

A 57-year-old woman hospitalized for a COVID-19 (coronavirus disease-2019)–related refractory acute respiratory distress syndrome developed a few days later anteroseptal ST-segment elevation with acute systolic dysfunction. Coronary angiography was performed with the patient in prone (face down) position, owing to the necessity to maintain a reasonable oxygen saturation during the examination. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2020;2:1302–6) © 2020 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

An otherwise healthy 57-year-old woman without previous history of cardiovascular disease was admitted into the emergency department for fever, cough, and severe fatigue for 2 days. She denied chest pain, dyspnea, and further symptoms. Physical examination revealed a blood pressure of 135/75 mm Hg, a heart rate of 104 beats/min, an arterial oxygen saturation of 81%, and a body temperature of 39.4°C. Given the coronavirus disease-2019 (COVID-19) pandemic, a reverse transcription polymerase chain reaction for severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) ribonucleic acid detection was performed and was positive. The patient was hospitalized and treated with oxygen (6 l/min), but within 24 h the patient developed acute respiratory distress syndrome (ARDS) that required mechanical ventilation, intensive care unit admission, and prone positioning due to a partial pressure of oxygen- to-fraction of inspired oxygen ratio of 57 in supine position. After a few hours, owing to a sudden blood pressure drop, a 12-lead electrocardiogram was repeated and showed an ST-segment elevation in the anteroseptal leads and an ST-segment depression with T-wave inversion in DIII and aVf (**Figure 1**).

LEARNING OBJECTIVES

- To describe the management of patients with refractory ARDS requiring coronary angiography.
- To describe the feasibility of coronary angiography with the patient in prone position.

PAST MEDICAL HISTORY

The patient had no past medical history and was not on any medications.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the *JACC: Case Reports* author instructions page.

Manuscript received April 26, 2020; revised manuscript received June 2, 2020, accepted June 3, 2020.

ISSN 2666-0849 https://doi.org/10.1016/j.jaccas.2020.06.012

DIFFERENTIAL DIAGNOSIS

The differential diagnosis included acute myocardial infarction, myocarditis, and takotsubo syndrome.

INVESTIGATION

Echocardiography showed anteroapical wall hypokinesia, with a left ventricular ejection fraction of 20% (Videos 1 and 2). High-sensitivity troponin T quickly increased from 119 ng/ml on the initial laboratory study to 989 ng/ml on the second sample (normal range 0 to 14 ng/ml). Given the echocardiographic changes, the regional wall motion abnormalities, and the elevated levels of myocardial necrosis markers, urgent coronary angiography was planned. However, the ARDS was so severe that it was not possible to perform the examination with a standard approach, owing to the rapid decrease of oxygen saturation, despite mechanical ventilation, in the supine position (oxygen saturation = 75% under 100% fraction of inspired oxygen).

MANAGEMENT

Given the need for emergency coronary angiography and the profound hypoxemia, the patient's position was changed from supine to prone position to allow a better lung expansion, with a dramatic improvement in oxygen saturation (>95%). Therefore, we decided to perform the coronary angiography by left transradial approach in prone position with the arm along the body side and the hand in supine position (Figure 2). The radial artery was accessed using a 20-gauge micropuncture needle through which a 0.025-inch guidewire was placed. A 6-F Radifocus Introducer II sheath (Terumo, Tokyo, Japan) was inserted into the artery. A cocktail containing nitroglycerin 200 μg and verapamil 2.5 mg was then injected through the side port of the sheath after hemodilution to a total volume of 10 ml.

The left main and the right coronary arteries were cannulated using the anteroposterior view with an EBU 3.5 launcher catheter (Medtronic, Minneapolis, Minnesota) and using the right anterior oblique view with a 6-F Judkins right catheter (Medtronic), respectively (Figure 3). Procedure time and chest radiograph time were 15 and 6.2 min, respectively. There was no evidence of obstructive coronary disease, and the final diagnosis was myocarditis, although we were not able to perform cardiac magnetic resonance in this highly unstable patient.

DISCUSSION

With a rapid spread worldwide, COVID-19 has become a public health emergency of international concern (1). The clinical course of SARS-CoV-2 infection is mostly characterized by respiratory tract symptoms, including fever, cough, pharyngodynia, fatigue, and complications related to pneumonia and ARDS, often

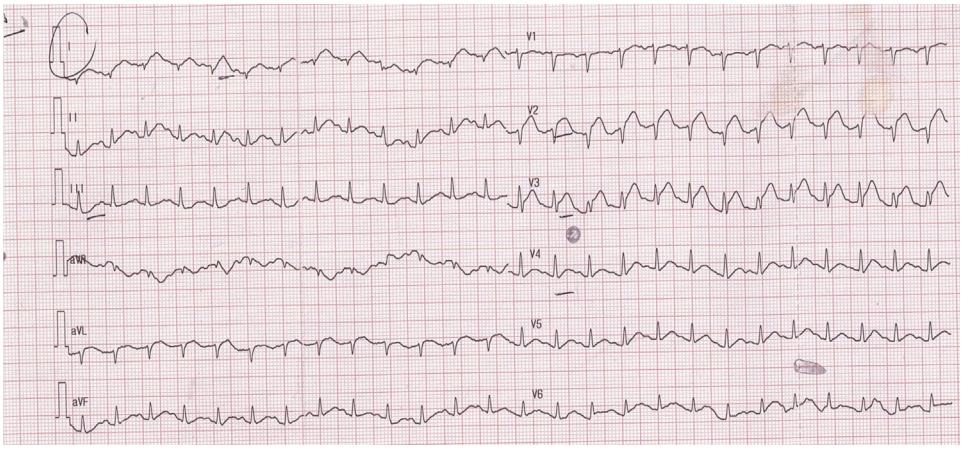
ABBREVIATIONS AND ACRONYMS

ARDS = acute respiratory distress syndrome

COVID-19 = coronavirus disease-2019

SARS-CoV-2 = severe acute respiratory syndrome-coronavirus-2

FIGURE 1 Electrocardiogram



Electrocardiogram showing ST-segment elevation in the anteroseptal leads and an ST-segment depression with T-wave inversion in DIII and aVf.

JACC: CASE REPORTS, VOL. 2, NO. 9, 2020
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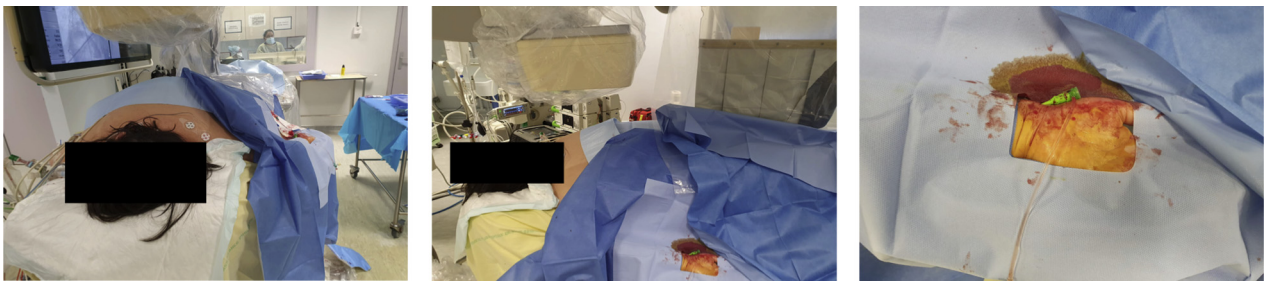
FIGURE 2 Patient Images

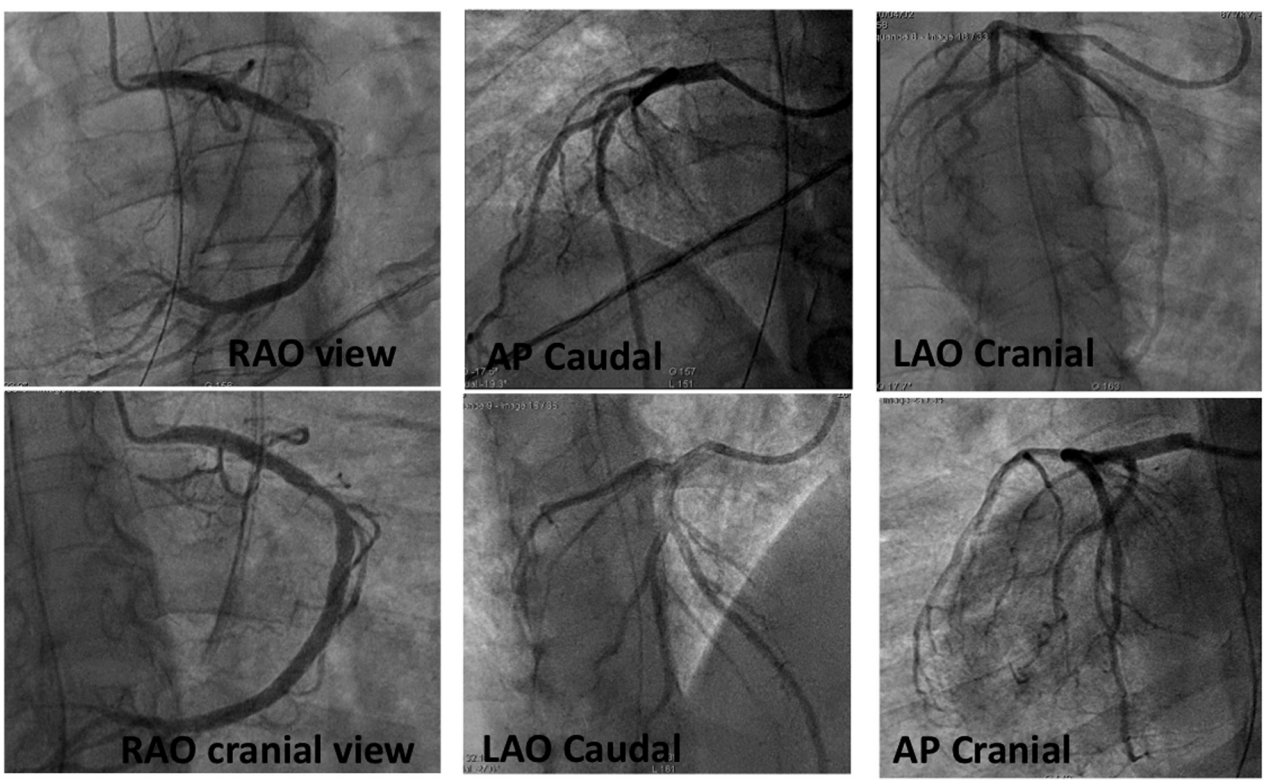


Images of the patient in prone position and vascular site access of the left transradial approach.

requiring mechanical ventilation (2). Data regarding cardiovascular involvement in SARS-CoV-2 infection are sparser, but it is now proven that myocardial damage or heart failure may occur (3). Coronary angiography is sometimes required in these patients, but its performance may be challenged by the dramatic hypoxemia related to the ARDS.

Prone position in refractory ARDS reduces the pleural pressure gradient from nondependent to dependent regions, in part through gravitational

FIGURE 3 Angiographic Images



Angiographic images of right and left coronary arteries acquired during coronary angiography performed with the patient in prone position. AP = anteroposterior; LAO = left anterior oblique; RAO = right anterior oblique.

effects and conformational shape matching of the lung to the chest cavity. As a result, lung aeration and strain distribution are more efficient. Therefore, prone positioning is a salvage therapy for some patients with severe ARDS and refractory hypoxemia (4,5).

Cardiac involvement has been described in patients with COVID-19 infection and can consist of not only myocarditis and type 2 myocardial infarction, but also type 1 myocardial infarction related to the proinflammatory and prothrombotic status in these patients likely to present cardiovascular risk factors (6,7). As a consequence, urgent coronary angiography is sometimes required, but may be challenging in patients with severe ARDS. Our article illustrates a case of coronary angiography through the left transradial approach in a patient requiring prone position to maintain adequate levels of oxygen saturation. Coronary angiography was performed without any important technical issues. The right coronary artery was selectively cannulated in right anterior oblique view and the left main coronary artery was selectively cannulated in anteroposterior view.

In a patient in prone position, the geometry and orientation of the heart as well as the coronary anatomy do not allow to obtain perfectly symmetric pictures of the coronary arteries using usual views. Consequently, the interpretation of coronary angiography was simply done following the heart's shape. This peculiar clinical situation is different from dextrocardia. Although we may assume that in a patient with dextrocardia, prone positioning may facilitate coronary angiography performance, it must be highlighted that cardiac orientation is not the same in patients with dextrocardia and supine positioning and in patients with levocardia and prone positioning. Thus, in dextrocardia, the most important challenges in performing coronary angiography are opposite-direction catheter rotations and mirror-like angiographic projections. Therefore, reversing right anterior oblique and left anterior oblique angles with unchanged cranial/caudal tilts (8,9) or using the double-inversion technique to normalize all angiographic pictures such as in a left-located heart (10) is usually enough to perform and analyze coronary angiography in such patients.

Finally, even though we did not perform percutaneous coronary intervention, performing percutaneous coronary intervention with a patient in prone position would not be a critical issue for an experienced operator.

FOLLOW-UP

The patient quickly developed cardiogenic shock unresponsive to vasopressor and end-stage renal failure requiring continuous renal replacement therapy. Five days later, death was inevitable because of multiorgan failure.

CONCLUSIONS

With the explosion of the COVID-19 pandemic and the large percentage of patients with cardiovascular risk factors presenting with refractory ARDS, prone position coronary angiography may be needed and can be performed with good safety and efficacy.

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REFERENCES

1. World Health Organization. Novel coronavirus – China. Available at: http://www.who.int/csr/don/12-january-2020-novel-coronavirus-china/en/. Accessed May 17, 2020.

2. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395:497–506.

3. Madjid M, Safavi-Naeini P, Solomon SD, Vardeny O. Potential effects of coronaviruses on the cardiovascular system: a review. JAMA Cardiol 2020 Mar 27 [E-pub ahead of print].

4. Koulouras V, Papathanakos G, Papathanasiou A, Nakos G. Efficacy of prone position in acute respiratory distress syndrome patients: a pathophysiology-based review. World J Crit Care Med 2016;5:121–36.

5. Guérin C, Reignier J, Richard J-C, et al. Prone positioning in severe acute respiratory distress syndrome. N Engl J Med 2013;368:2159–68.

6. Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with

COVID-19 in Wuhan, China: a retrospective cohort study. Lancet 2020;395:1054–62.

7. Inciardi RM, Lupi L, Zaccone G, et al. Cardiac involvement in a patient with coronavirus disease 2019 (COVID-19). JAMA Cardiol 2020 Mar 27 [E-pub ahead of print].

8. Moreyra AE, Saviano GJ, Kostis JB. Percutaneous transluminal coronary angioplasty in situs inversus. Catheter Cardiovasc Diagn 1987;13:114–6.

9. Jauhar R, Gianos E, Baqai K, Roethel M, Kaplan BM. Primary angioplasty in a patient with dextrocardia. J Interv Cardiol 2005;18:127–30.

10. Goel PK. Double-inversion technique for coronary angiography viewing in dextrocardia. Catheter Cardiovasc Interv 2005;66:281–5.

KEY WORDS coronary angiography, COVID-19, heart failure

APPENDIX For supplemental videos, please see the online version of this paper.