



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Clinical Communications: Adult

SUPERIOR MESENTERIC ARTERIAL AND VENOUS THROMBOSIS IN COVID-19

Uthayakumar Amaravathi, MD, Nathan Balamurugan, MD, Vivekanandan Muthu Pillai, MD, and
S. Manu Ayyan, MD

Department of Emergency Medicine, Jawaharlal Institute of Postgraduate Medical Education and Research, Pondicherry, India
Corresponding Address: Nathan Balamurugan, MD, Department of Emergency Medicine, JIPMER, Pondicherry 605006, India

Abstract—Background: Patients with coronavirus disease 2019 (COVID-19) commonly present with fever, constitutional symptoms, and respiratory symptoms. However, atypical presentations are also well known. Though isolated mesenteric arterial occlusion associated with COVID-19 has been reported in literature, combined superior mesenteric arterial and venous thrombosis is rare. We report a case of combined superior mesenteric arterial and venous occlusion associated with COVID-19 infection. **Case Report:** We report a case of a 45-year-old man who was a health care worker who presented to the emergency department with severe abdominal pain. The clinical examination was unremarkable, but imaging revealed acute mesenteric ischemia caused by superior mesenteric artery and superior mesenteric vein occlusion. Imaging of the chest was suggestive of COVID-19 infection, which was later confirmed with reverse transcription polymerase chain reaction of his nasopharyngeal swab. To date, only 1 case of combined superior mesenteric artery and superior mesenteric vein thrombosis caused by COVID-19 has been reported. **Why Should an Emergency Physician Be Aware of This?:** During the COVID-19 pandemic it is important to keep mesenteric ischemia in the differential diagnosis of unexplained abdominal pain. Routinely adding high-resolution computed tomography of the chest to abdominal imaging should be considered in patients with acute abdomen because it can help to identify COVID-19 immediately. © 2020 Elsevier Inc. © 2020 Elsevier Inc. All rights reserved.

Keywords—COVID-19; emergency department; superior mesenteric artery occlusion; superior mesenteric vein occlusion

INTRODUCTION

Coronavirus disease 2019 (COVID-19) caused by the novel severe acute respiratory syndrome coronavirus 2 has caused a devastating pandemic affecting >81 million people resulting in 1.8 million deaths worldwide as of January 1, 2021 (1). More than a year into the epidemic, our knowledge of the virus and the disease is quite limited. Patients with COVID-19 commonly present with fever, constitutional symptoms, and respiratory symptoms. However, atypical presentations are well known, particularly arterial or venous occlusion including stroke, myocardial infarction, acute limb ischemia, mesenteric ischemia, deep venous thrombosis, and pulmonary embolism (2). We report an unusual combination of superior mesenteric artery (SMA) and superior mesenteric vein (SMV) occlusion in a patient with COVID-19.

CASE REPORT

A 45-year-old man working as a health care worker in our hospital presented to the emergency department (ED) with acute abdominal pain of 2 hours' duration. The pain was excruciating in nature and did not respond to narcotic analgesia. The pain was felt in the epigastric and umbilical region and did not radiate anywhere else.

Reprints are not available from the authors.

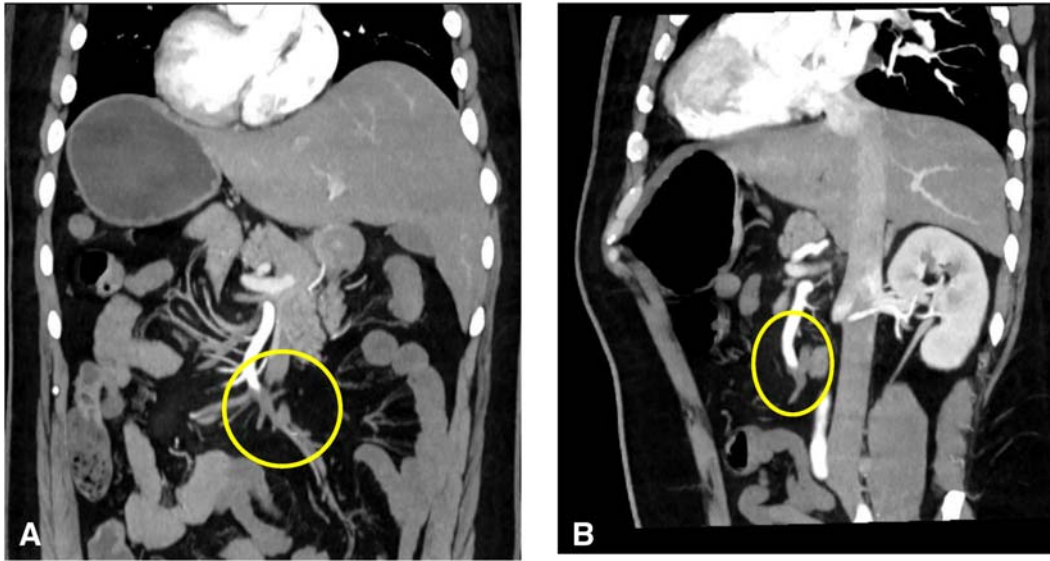


Figure 1. Coronal reconstruction (A) and sagittal oblique reconstruction (B) of the arterial abdominal computed tomography scan showing superior mesenteric artery thrombus.

He vomited once and the vomitus was unremarkable. There was no fever, loose stools, hematemesis, melena, or bleeding per rectum. He did not have any comorbidities and was not taking any medications regularly. On examination he was diaphoretic, but his vital signs were stable with a pulse rate of 58 beats/min, blood pressure of 140/90 mm Hg, a respiratory rate of 18 breaths/min, and oxygen saturation of 98% on room air. His abdomen was soft, nontender, and nondistended, with normal bowel sounds. Cardiovascular and respiratory systems were unremarkable. An electrocardiogram revealed sinus bradycardia but was otherwise normal. Initially, he was treated with intravenous pantoprazole, ondansetron, and morphine. The pain did not resolve and he was also given fentanyl for pain relief.

Radiographs and ultrasound of the abdomen were normal. Given his persistent pain, which was out of proportion to the examination findings, mesenteric ischemia was suspected, and the patient underwent an emergency computed tomography (CT) angiogram. CT angiography revealed a thrombotic occlusion of the SMA and SMV (Figures 1 and 2). To our surprise, the abdominal imaging, which covered the lower part of the lungs, revealed features suggestive of COVID-19 infection. The patient had a high-resolution CT scan of his thorax, which revealed bilateral peripheral ground glass opacities with a CO-RADS grade of 5 and a CT severity index of 5 (Figure 3). The patient had not reported any COVID-19-related symptoms at presentation, but on careful questioning we also obtained information that he had a mild fever and sore throat for 5 days before presentation and for which he did not seek medical attention. A reverse transcriptase polymerase chain reaction study of his naso-

pharyngeal swab came back positive for severe acute respiratory syndrome coronavirus 2. His transthoracic echocardiogram showed a normal left ventricular ejection fraction with no evidence of clot. His blood investigations revealed a lipase of 40 IU/L, lactate dehydrogenase of 1.3 mmol/L, D-dimer of 5.30 mg/L (reference <0.50 mg/L), a serum ferritin level of 324.3 ng/ml, and a normal CRP. Once the diagnosis was confirmed the



Figure 2. Coronal reconstruction of the portal abdominal computed tomography scan showing a superior mesenteric vein thrombus.



Figure 3. High-resolution computed tomography scan of the basal lung segments showing peripheral ground glass opacities.

patient was started on an intravenous course of unfractionated heparin. He was immediately taken for laparotomy with SMA thrombectomy. A relook laparotomy after 48 h revealed a 103-cm long gangrenous bowel segment that was resected and end jejunostomy with distal ileal mucous fistula was performed.

DISCUSSION

COVID-19 creates a prothrombotic milieu. It predisposes the patient to both micro- and macrovascular thrombosis, which predominantly affects the venous system (3). Arterial occlusion is less common, mostly affecting the cerebral and coronary vessels (Table 1). There are only a few case reports of COVID-19–related SMA thrombosis. The exact mechanism for thrombosis in COVID-19 is unknown. Hypoxia, inflammatory mediators, thrombocytopenia, immobilization, and liver injury secondary to angiotensin-converting enzyme 2 receptor expression

are the proposed mechanisms (3). In general, pre-existing cardiac disease, peripheral artery disease, advanced age, traumatic injury, and low cardiac output states are the major risk factors for acute mesenteric arterial occlusion (4). Our patient did not have any such risk factors making us suspect COVID-19–related thrombosis.

Seven cases of COVID-19–related SMA thrombosis have been reported so far, and in that small sample just 1 patient had both SMA and SMV thrombosis (5). Of those 7 patients, 5 presented with respiratory symptoms and subsequently developed SMA thrombosis during their hospital stay, but 2 of them had abdominal pain as their only presenting symptom (Table 2).

Studies have shown that D-dimer tends to rise early in mesenteric ischemia and has a sensitivity of 95% in diagnosing intestinal ischemia. Consistently elevated D-dimer is also an independent predictor of poor outcomes (6,7). Our patient had an elevated D-dimer and normal CRP values at presentation. During his hospital stay, D-dimer remained elevated but CRP continued to be normal. This phenomenon may represent the resolution of COVID-19 infection but an ongoing thromboembolism. A similar discrepancy in the values of D-dimer and CRP over time—such as an elevated D-dimer and declining CRP levels—was observed in a case series of pulmonary embolism caused by COVID-19 (8). In COVID-19, a high CRP level is associated with an increase in disease severity (9). Our patient had normal CRP levels, presumably because he had only mild disease (no constitutional or respiratory symptoms at presentation and a CT severity score of only 5, suggesting mild disease).

Ultrasound examination in the early phase may show SMA occlusion and bowel spasm. In the intermediate phase, ultrasound is not useful because of the presence of an increased amount of gas-filled intestinal loops. In the late phase, ultrasound may reveal fluid-filled lumen, bowel wall thinning, evidence of extraluminal fluid and decreased or absent peristalsis (10). CT angiography is the best diagnostic modality and has a sensitivity and specificity of 89.4% and 99.5%, respectively, for diagnosing acute mesenteric ischemia (11).

Table 1. Incidence of Thromboembolism in Patients with COVID-19 Based on the Studies Published on Hypercoagulability in COVID-19

Type of Thromboembolism	Abou-Ismaïl et al. (7) Incidence, % (Min–Max)	Singhania et al. (12) Incidence, % (Min–Max)
VTE	18.7–69	4.4–79
ACS	1.1	1.1
Ischemic stroke	1.3–3.7	1.3–3.7
Mesenteric ischemia	0.7	0.7
Acute limb ischemia	0.7–16.3	0.7–16.3

ACS = acute coronary syndrome; COVID-19 = coronavirus disease 2019; VTE = venous thromboembolism.

Table 2. Demographic and Clinical Characteristics of the Reported Cases of Mesenteric Ischemia in COVID-19

Author, Month, and Year	Age, Years	Gender	Comorbidities	Complaint for Which Patient Was Admitted	D-Dimer/CRP Levels on Day of Admission	Treatment Given	Outcome
de Barry et al. (5), April 2020	79	F	None	Abdominal pain	NA/125 mg/dL	Thrombectomy and intestinal resection	Died
A Beccara et al. (13), April 2020	52	M	None	Respiratory symptoms	NA/44 mg/dL	Intestinal resection with side-to-side anastomosis	Survived
Ignat et al. (14), May 2020	28	F	None	Abdominal pain	NA/NA	Bowel resection and laparotomy	Survived
Ignat et al. (14), May 2020	56	M	Diabetes and hypertension	Respiratory symptoms	NA/NA	Bowel resection and laparotomy	Not known
Ignat et al. (14), May 2020	67	M	Chronic bronchitis, diabetes, status postcardiac transplant	Respiratory symptoms	NA/NA	Medical treatment	Died
Bianco et al. (15), June 2020	59	M	Hypertension	Respiratory symptoms	30-fold increase/NA	Small bowel resection with side-to-side anastomosis	Died
Karna et al. (16), July 2020	61	F	Diabetes and hypertension	Respiratory symptoms	NA/343 mg/dL	Resection of gangrenous bowel and loop ileostomy	Died

COVID-19 = coronavirus disease 2019; CRP = C-reactive protein; F = female; M = male; NA = not available.

In thrombotic mesenteric arterial occlusion, fluid resuscitation, analgesia, anticoagulation, and broad-spectrum antibiotics should be started in the ED, after which the patient should be taken for emergency laparotomy (4).

WHY SHOULD AN EMERGENCY PHYSICIAN BE AWARE OF THIS?

We have described a case of combined SMA and SMV thrombosis related to COVID-19 infection. This is the second such case report in the world and first from Asia. Sudden onset persistent abdominal pain that remains unexplained by clinical evaluation and basic investigations should raise the suspicion of mesenteric ischemia, and a COVID-19–related prothrombotic state should be considered. D-dimer is a highly sensitive investigation for the prothrombotic state caused by COVID-19. Further evaluation of COVID-19, including reverse transcriptase polymerase chain reaction and a high-resolution computed tomography scan of the chest are essential. Examining the lower parts of the lung visible in the abdominal imaging itself can detect COVID-19.

Acknowledgments—Informed consent was obtained from the patient for the publication of the case report and the use of perioperative data for research purposes.

REFERENCES

- World Health Organization website. WHO coronavirus disease (COVID-19) dashboard. Available at: <https://covid19.who.int>. Accessed January 1, 2021.
- Pan L, Mu M, Yang P, et al. Clinical characteristics of COVID-19 patients with digestive symptoms in Hubei, China: a descriptive, cross-sectional, multicenter study. *Am J Gastroenterol* 2020;115:766–73.
- Klok FA, Kruip MJHA, van der Meer NJM, et al. Incidence of thrombotic complications in critically ill ICU patients with COVID-19. *Thromb Res* 2020;191:145–7.
- Oldenburg WA, Lau LL, Rodenberg TJ, Edmonds HJ, Burger CD. Acute mesenteric ischemia: a clinical review. *Arch Intern Med* 2004;164:1054–62.
- de Barry O, Mekki A, Diffre C, Seror M, El Hajjam M, Carlier RY. Arterial and venous abdominal thrombosis in a 79-year-old woman with COVID-19 pneumonia. *Radiol Case Rep* 2020;15:1054–7.
- Montagnana M, Danese E, Lippi G. Biochemical markers of acute intestinal ischemia: possibilities and limitations. *Ann Transl Med* 2018;6:341.
- Abou-Ismaïl MY, Diamond A, Kapoor S, Arafah Y, Nayak L. The hypercoagulable state in COVID-19: incidence, pathophysiology, and management. *Thromb Res* 2020;194:101–15.
- Becher Y, Goldman L, Schacham N, Gringauz I, Justo D. D-dimer and C-reactive protein blood levels over time used to predict pulmonary embolism in two COVID-19 patients. *Eur J Case Rep Intern Med* 2020;7:001725.
- Gong J, Dong H, Xia QS, et al. Correlation analysis between disease severity and inflammation-related parameters in patients with COVID-19: a retrospective study. *BMC Infect Dis* 2020;20:963.
- Reginelli A, Genovese E, Cappabianca S, et al. Intestinal ischemia: US-CT findings correlations. *Crit Ultrasound J* 2013;5(suppl 1):S7.

11. Henes FO, Pickhardt PJ, Herzyk A, et al. CT angiography in the setting of suspected acute mesenteric ischemia: prevalence of ischemic and alternative diagnoses. *Abdom Radiol N Y* 2017;42: 1152–61.
12. Singhanian N, Bansal S, Nimmatoori DP, Ejaz AA, McCullough PA, Singhanian G. Current overview on hypercoagulability in COVID-19. *Am J Cardiovasc Drugs* 2020;20:393–403.
13. Beccara L, Pacioni C, Ponton S, Francavilla S, Cuzzoli A. Arterial mesenteric thrombosis as a complication of SARS-CoV-2 infection. *Eur J Case Rep Intern Med* 2020;7:001690.
14. Ignat M, Philouze G, Aussenac-Belle L, et al. Small bowel ischemia and SARS-CoV-2 infection: an underdiagnosed distinct clinical entity. *Surgery* 2020;168:14–6.
15. Bianco F, Ranieri AJ, Paterniti G, Pata F, Gallo G. Acute intestinal ischemia in a patient with COVID-19. *Tech Coloproctol* 2020;24: 1217–8.
16. Karna ST, Panda R, Maurya AP, Kumari S. Superior mesenteric artery thrombosis in COVID-19 pneumonia: an underestimated diagnosis - first case report in Asia. *Indian J Surg* 2020. [Epub ahead of print].