



ORIGINAL RESEARCH PAPER

Radiology

ARTERIAL THROMBOSIS- A COMPLICATION OF COVID-19 PNEUMONIA: A CASE SERIES REPORT

KEY WORDS: Arterial thrombosis, Pulmonary arterial thrombosis, Systemic arterial thrombosis, Peripheral arterial thrombosis, COVID-19, Coagulopathy

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ABSTRACT

Since the outbreak of COVID-19 virus infection in December 2019, the virus has rapidly spread across the globe causing pandemic. A variety of vascular complications have been associated with novel COVID-19 virus infection such as venous and arterial thromboembolism. Arterial thrombosis is a recognized complication of COVID-19 pneumonia suggesting the possibility of deranged coagulation profile induced by the COVID-19 virus. Arterial thrombosis can be both early and delayed manifestation of COVID-19 infection with varying presentation depending on the system involved and it can occur in patients with or without comorbidities thus prompting physicians for its early diagnosis, management and reduction of associated complications. We discuss six cases of COVID-19 patients with pulmonary and systemic arterial thrombosis with varying presentations.

Cases:

Patient 1: A 41 years old male.

Clinical history:

Diffuse abdominal pain which was aggravated by food, vomiting and fever for 1 day with no known comorbidities/history of smoking. Patient had tested positive for COVID-19 three days prior to abdominal symptoms and was undergoing treatment in ICU for the same. Patient had no previous history of similar complaints.

On examination:

Patient was normotensive (BP- 130/80 mm Hg), conscious and afebrile, SpO2 was 95%. On systemic examination- abdomen was distended, soft with diffuse tenderness, guarding was present, no e/o rigidity, bowel sounds could be heard. Rest of the systemic examination was unremarkable.

Lab reports:

Mild leukocytosis (13.1 x 10⁹/L), elevated C-reactive protein (22mg/L: 0-10mg/L), fibrinogen was slightly raised (4.1 g/L; 1.5-3.5 g/L), activated plasma thromboplastin time was below normal (23s;26-37s).

In view of abdominal complaints and suspicion of arterial thrombosis, CECT abdomen and abdominal angiogram was performed.

Imaging features:

- Eccentric partial thrombus in suprarenal aorta with extension to celiac artery with its significant luminal narrowing and minimal narrowing of ostium of SMA (shown in Figure 1a)
- Complete thrombosis of distal SMA around 8-9 cm distal to ostium with extension of the thrombus to most of the left jejunal and ileal branches of the SMA (shown in Figure 1 b, c)



Image 1: (a) CECT with abdominal angiogram showing eccentric supra renal aortic thrombus extending to celiac trunk and SMA ostia (red arrow), (b) Abdominal angiogram

showing complete occlusion of distal SMA (yellow arrow), (c) 3D reconstruction of computed tomography angiogram of same patient showing complete occlusion of distal SMA (yellow arrow).

Treatment:

Thrombus was mechanically suctioned and patient was given intra-arterial thrombolytics, gangrenous bowel was resected and ileo-ileal anastomosis was performed.

Patient 2: A 63 years old male

Clinical history:

He was admitted in hospital in view of COVID-19 symptoms and tested positive for the same. A week after admission, he complained of severe diffuse abdominal pain which was not relieved by analgesic medication. In view of history of COVID-19 infection and acute onset of abdominal symptoms and suspicion of arterial thrombosis, CECT abdomen and abdominal aortogram was performed

On examination:

Patient was normotensive (BP- 126/80 mm Hg), conscious and febrile (99° F), HR- 100bpm, SpO2 was 92%. On systemic examination- abdomen was distended with diffuse tenderness, guarding & rigidity was present, reduced bowel sounds. Rest of the systemic examination was unremarkable.

Lab reports:

Leukocytosis (16 x 10⁹/L: 4-11 x10⁹/L), elevated C-reactive protein (25mg/L: 0-10mg/L), fibrinogen was slightly raised (4.5g/L; 1.5-3.5 g/L), activated plasma thromboplastin time was below normal (22s;26-37s).

In view of abdominal complaints and suspicion of bowel obstruction and arterial thrombosis CECT abdomen and abdominal angiogram was performed.

Imaging features;

- Dilated jejunal and mid ileal loops with air fluid levels with relative hypoenhancement of the bowel wall.
- Partial eccentric thrombosis of descending thoracic aorta extending into supra-renal abdominal aorta for 15 cm length along anterior and left lateral wall causing a maximum of ~ 50 percent diameter stenosis. Maximum thickness of thrombus ~ 14 mm. Eccentric thrombus was involving celiac and superior mesenteric artery origin (shown in Figure 2a).
- Complete non-opacification of coeliac trunk throughout

its length however common hepatic artery and its branches, left gastric and splenic arteries show reanalyzed collateral flow (shown in Figure 2b).

- Complete thrombosis of proximal superior mesenteric artery for a length of ~ 3 cm followed by focus of patchy opacification secondary to collateral flow through superior-inferior pancreaticoduodenal artery stenosis. This is followed by complete thrombosis of distal superior mesenteric artery up-to its termination with patchy recanalized collateral flow in its right colic and middle colic branches (shown in Figure 3a, b).
- Non-contrast opacification of jejunal and ileal branches of superior mesenteric artery.
- Renal and inferior mesenteric vessels show normal course with maintained flow
- Bilateral common iliac arteries, internal and external iliac arteries show normal course with maintained flow

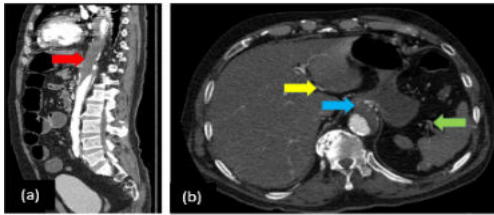


Image 2: (a) CECT abdomen and abdominal aortogram showing eccentric thrombus of descending thoracic aorta extending into supra renal abdominal aorta (red arrow), (b) Complete non opacification of celiac trunk (blue arrow), recanalised flow in common hepatic artery (yellow arrow) and splenic artery (green arrow).

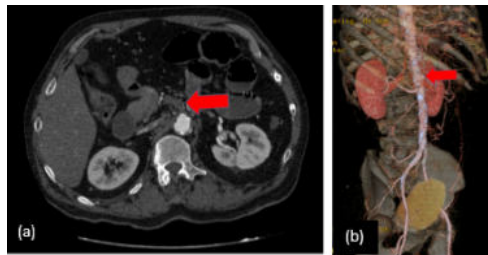


Image 3: (a) CECT abdomen and abdominal aortogram showing complete obliteration of SMA by thrombus (red arrows), (b) 3D reconstruction of same patient showing non-opacification of SMA.

Patient 3: A 33 years old female

Clinical history: She was admitted with complaints of sudden onset of right lower limb pain with paresthesia for about 8 hours duration. Patient was undergoing treatment as an inpatient in a local hospital for lower GI complaints of diarrhea and abdominal pain. Patient is known case of RHD with MS since many years. There was past history of embolic (?) occlusion of left lower limb arteries which was managed conservatively. Patient was not on anti-coagulation therapy and tested positive for COVID-19 at the time of presentation to hospital.

On examination:

She had cold extremities. Left lower limb Doppler revealed poor flow in anterior tibial artery and dorsalis pedis artery. Echo revealed rheumatic heart disease, dilated left atrium, moderate MS, trivial MR, mild AR, no AS, mild TR/PAH, normal left systolic function.

Lab reports:

Mild leukocytosis (11.2 x 10⁹/L; 4-11 x10⁹/L), platelets 2.1 lacs. markedly elevated C-reactive protein (125mg/L; 0-10mg/L), fibrinogen was raised (5g/L; 1.5-3.5 g/L), activated plasma thromboplastin time was below normal (22s; 26-37s). In view of suspected embolism, bilateral lower limb CT angiogram was performed.

Imaging features:

- Saddle thrombosis involving infra renal segment of abdominal aorta extending to bilateral proximal common iliac arteries (shown in Figure 4a).
- Right leg: Non-opacification of distal external iliac artery and right proximal common femoral artery with reformatting distal flow by inferior epigastric artery (shown in Figure 4b, c).
- Left leg: long segment non-opacification of distal superficial femoral artery extending to popliteal artery with reformatting distal flow by profunda femoris artery. Long segment occlusion of distal anterior distal tibial artery, dorsalis pedis artery with no reformatting distal flow (shown in Figure 5a, b, c).

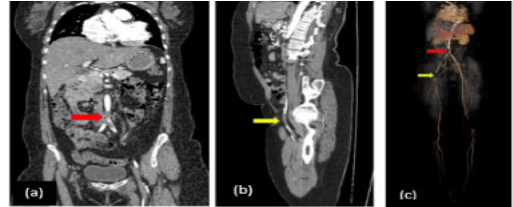


Image 4: (a) Coronal section of CECT abdomen with abdominal and lower limb angiogram showing Saddle thrombosis of infra renal abdominal aorta extending into bilateral proximal common iliac arteries (red arrows), (b) Sagittal section showing Non-opacification of right external iliac artery and common femoral artery (yellow arrows), (c) 3D reconstruction of same patient showing non-opacification of bilateral proximal common iliac arteries (red arrow), right external iliac artery and common femoral artery (yellow arrows).

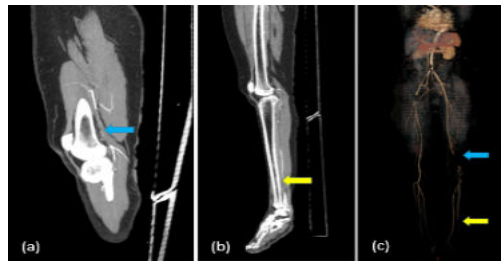


Image 5: (a) CECT abdomen with abdominal and lower limb angiogram showing non-opacification of left distal superficial femoral artery extending to popliteal artery (blue arrows) with reformatting distal flow by profunda femoris artery, (b) Long segment occlusion of distal anterior distal tibial artery, dorsalis pedis artery (yellow arrows), (c) 3D reconstruction of same patient showing opacification of left distal superficial femoral artery extending to popliteal artery (blue arrows) and long segment occlusion of distal anterior distal tibial artery, dorsalis pedis artery (yellow arrows).

Treatment:

Patient was managed conservatively with anticoagulants, diuretics and other supportive material. after treatment, patient was stable and was discharged with advice regarding further course of medical treatment and follow up.

Patient 4: A 38 years old male with diabetes mellitus was diagnosed with COVID-19 pneumonia for which he was receiving treatment in another hospital at Udupi.

History of present illness: He had sudden onset of severe abdominal pain of one-day duration and was referred to our hospital. On examination patient was conscious, oriented and hemodynamically stable.

General examination was normal. Systemic examination revealed diffuse abdominal tenderness. baseline investigations were performed which showed elevated neutrophilic leucocytes and elevated inflammatory markers.

In view of suspected mesenteric ischemia CECT abdomen was performed.

Imaging features:

- Acute superior mesenteric artery thrombosis (shown in Figure 6a), two gangrenous bowel segments from duodeno-jejunal flexure to mid jejunum and also from proximal to distal ileum.
- Bilateral renal ischemia (shown in Figure 6b).



Image 6: CECT abdomen with abdominal angiogram showing (a) Thrombosis of superior mesenteric artery with near complete occlusion (yellow arrow), (b) wedge shaped non enhancing areas in bilateral kidneys- consistent with renal infarcts (red arrows).

Management: Immediate mechanical clot aspiration with intra-arterial thrombolysis was performed with resection of gangrenous bowel and ileo-ileal and jejuno-jejunal anastomosis was done. Post-surgery and mechanical thrombectomy, patient improved markedly and was kept under close observation in ICU.

Patient 5: A 82 years old male

Clinical history:

He was admitted with complains of severe breathlessness and anosmia and was found to be positive for COVID-19. He was hypoxic on admission with grossly elevated inflammatory markers including D-dimer (6.85µg/ml; 0.0-0.5 µg/ml). HRC T + CTPA was done for further evaluation.

Imaging features:

- Severe level of infection with partial thrombosis of right pulmonary artery and its branches (shown in figure 7a, b)

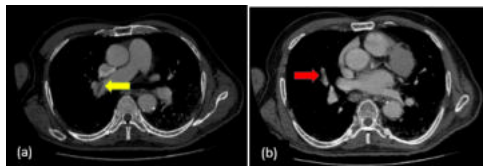


Image 7: Axial sections of pulmonary angiogram showing (a) Partial occlusion of right pulmonary artery (yellow arrow) and (b) its branches (red arrow).

Management: Patient was treated with Remdesivir and therapeutic doses of low molecular weight heparin. Inflammatory markers were repeated and patient was closely monitored, there was marked improvement in symptoms post treatment.

Patient 6: A 52 years old man

Clinical history:

Patient was undergoing treatment for COVID-19 pneumonia in ICU facility. 10 days after admission, he started to complain of sudden onset pain in left lower limb.

On examination:

Left leg was cold compared to the right side. Left lower limb Doppler revealed poor flow in distal popliteal artery, anterior tibial artery, posterior tibial artery and dorsalis pedis artery.

Lab reports:

Mild leukocytosis (12.9x 10⁹/L: 4-11 x10⁹/L), Platelets- 1.9 lacs, markedly elevated C-reactive protein (75mg/L: 0-10mg/L), fibrinogen was raised (4.5g/L; 1.5-3.5 g/L), activated plasma

thromboplastin time was below normal (22.7s;26-37s).

On high suspicion of arterial thrombosis, lower limb CT angiogram was performed.

Imaging features:

Complete obliteration of left popliteal artery and its distal branches including posterior tibial artery, anterior tibial artery and peroneal trunk (shown in Figure 8a, b)

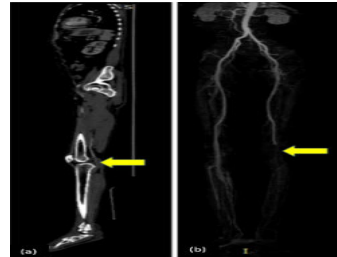


Image 8: (a,b) Lower limb angiogram showing complete occlusion of left popliteal artery and its branches (yellow arrows).

DISCUSSION:

We report six COVID-19 pneumonia cases with varying degrees of presentation of arterial thrombosis with wide spectrum of arterial involvement including thoracic and abdominal aorta & its branches, pulmonary artery & its branches and peripheral arterial system. We noticed that these symptoms ranged from three days after testing positive for COVID-19 to two weeks after testing negative for COVID-19.

The underlying cause of COVID-19 associated coagulopathy is not clearly understood. Various mechanisms suggest activation of coagulation cascade due to inflammation by viral infection. Tissue factor (TF) is expressed on many cell types and in all blood tissue barriers. At the site of injury to endothelial cell layer of blood vessels, factor VIIa exposure to TF results in catalysis of coagulation cascade. In addition, virus stimulates expression and production of TF on monocytes and endothelial cells. Also, release of IL-8, IL-1, CXCC-10 and TNF-α has an additive role in procoagulant pathway activation (Scharer, 2018). In addition, a multivariate analysis has shown an increase in immature platelets in circulating pool due to increase platelet turnover which in turn increases risk of arterial thrombosis and poor patient outcome (Cohen et al., 2021). Zhang et al, showed in their study that binding of platelets with ACE-2 results in their direct activation and precipitates thrombus formation (Zhang et al., 2020).

The risk of venous thromboembolism is 2-3 folds in patients affected with COVID-19 (Whiteley & Wood, 2022). Abnormal coagulation profile is associated with poor prognosis and longer hospital stays (Tang et al., 2020). The median time of thrombosis from testing positive for COVID-19 is 14 days (Vulliamy et al., 2020). In our cases, thrombosis of suprarenal aorta was seen three days to one week after testing positive for COVID-19. A higher incidence of arterial thrombosis has been reported in patients with comorbidities (Cheruiyot et al., 2021). In our study, arterial thrombosis was also seen in patient without any comorbidity (Case 1). Whereas, in a known case of Rheumatic heart disease with mitral valve stenosis and previous history of embolic episode in lower limb arteries, there was sudden onset of recurrence of lower limb ischemia attributable to COVID-19 induced coagulopathy (Case 3).

CONCLUSION:

Arterial thrombosis is a complication of COVID-19 pneumonia which can have an early or delayed onset. (Angelillis et al., 2021) Therefore, the clinician needs to be

aware of the possibility of arterial thrombosis in this setting and in suspected and high risk cases with thromboembolism prophylactic anti coagulation therapy can be started to avoid the complications of arterial thrombosis (Schweblin et al., 2020).

CONSENT:

Informed consent from patient/guardian could not be obtained after exhaustive efforts for the same over the period of 9 months. Patients' information has been anonymized to protect patients' identity.

LEARNING POINTS:

- Arterial thrombosis can have early or delayed onset in setting of COVID-19 pneumonia
- There is involvement of both systemic and peripheral arterial vasculature
- Early diagnosis and treatment can help in better prognosis.

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