Original Article

Clinical Spectrum, Management Strategies, and Outcomes of Abdominal and Limb Vascular Ischemia in COVID-19: An Observational Study

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How to cite this article: Mohammad Dungarpurwala, Abhijit Budhkar , Anuradha Panchal, Niket Attarde, Meena Kumar, Isha Birdi, Shristi Visen. Clinical Spectrum, Management Strategies, and Outcomes of Abdominal and Limb Vascular Ischemia in COVID-19: An Observational Study. International Journal of Contemporary Surgery / Vol 13 No. 2, July - December 2025

Abstract

COVID-19 exhibits wide spectrum of clinical manifestations, from mild symptoms to severe thrombotic events-death. Vascular coagulopathy plays critical role in severe complications. Patients with pre-existing peripheral vascular disease (PVD) are at heightened risk due to endothelial dysfunction, inflammation, and prothrombotic state. Present study aimed to evaluate vascular complications associated with COVID-19 & assess role of antithrombotic agents & corticosteroids during early (golden) stage of infection.

Methods: This observational study was conducted in Department of General Surgery at D.Y. Patil School of Medicine, Nerul, Navi Mumbai, from Jan 2021–Dec 2022. 20 patients with confirmed COVID-19 & vascular ischemia involving abdomen and/or limbs were enrolled based on RT-PCR results, CT Severity Scores (CT-SS >5), CORADS >5, antibody positivity, and/or previous history of PVD. Detailed clinical assessment, laboratory investigations, imaging (Doppler studies, CECT, CT angiography), operative procedures, postoperative outcomes recorded. Patients followed for 1month post-discharge. Statistical analysis performed using SPSS v21, with Chi-square tests applied for categorical variables ($p<0.05$ considered significant). Mean age was 55.1 ± 11.9 years, with 75% males. Comorbidities included hypertension (25%), diabetes (10%), diabetes with hypertension (15%), other combinations including hypothyroidism, tuberculosis, and IHD (5% each). Laboratory abnormalities included elevated CRP, D-dimer, PT, leukocytosis (5% each). Imaging revealed SMA thrombosis as most frequent thrombus site (25%), followed by femoral artery involvement (15%). Surgical interventions included exploratory laparotomy with resection/anastomosis (15%), laparotomy with ileostomy (15%), right below-knee amputation (15%), femoropopliteal grafting (5%), and thromboembolectomy (5%), while 20% were managed

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Submission: Oct 9, 2025 **Revision:** October 29, 2025 **Published date:** November 4 , 2025

conservatively. 17 patients (85%) were fully vaccinated, yet thrombotic events were still observed. Statistically significant association was found between thrombus location & surgical procedure performed (p=0.031). No significant association was observed between prior use of antiplatelet agents and diagnosis (p=0.154).

Conclusion: COVID-19 associated with significant vascular complications, particularly SMA thrombosis and femoropopliteal involvement, even in fully vaccinated patients. Early imaging, prompt diagnosis, and timely surgical intervention are crucial to prevent limb loss and improve survival. While antiplatelet use did not significantly impact thrombus occurrence, further multicentric studies with larger sample sizes are needed to clarify preventive role of antithrombotic therapy and vaccination in mitigating vascular complications.

Introduction

COVID-19 presents with a broad spectrum of clinical manifestations ranging from asymptomatic infection to moderate symptoms, severe thrombotic events, acute respiratory distress syndrome (ARDS), and mortality. As our understanding of the disease has evolved, it has become evident that widespread vascular coagulopathy and infection-induced inflammatory responses are central to many of its severe complications, including respiratory failure and death [1]. Identifying subpopulations at higher risk of adverse outcomes following SARS-CoV-2 infection remains critical as the virus continues to spread globally.

Peripheral artery disease (PAD) a common, yet often underdiagnosed, manifestation of peripheral vascular disease (PVD) shares several pathophysiological mechanisms with COVID-19, including endothelial dysfunction, inflammation, and a prothrombotic state [2]. Despite this overlap, little is known about how SARS-CoV-2 infection may influence outcomes in patients with existing PVD, who are inherently vulnerable due to their cardiovascular comorbidities.

Globally, over 200 million people (4.5%) of total population are affected by PVD, a major form of atherosclerotic vascular disease [3]. The condition involves pathological changes to peripheral arteries, such as stenosis, occlusion, or aneurysmal dilation, which can significantly impair blood flow and lead to ischemic complications, including limb amputation [4,5]. Beyond its physical impact, PVD severely affects patients' quality of life and imposes a high healthcare burden. Compared to other pandemic viral illnesses such as HIV, PVD is associated with higher morbidity and mortality rates [6], underscoring the importance of focused management strategies especially during global health crises.

However, during the initial stages of the COVID-19 pandemic, the continuity of care for PVD patients was significantly disrupted. Outpatient follow-up appointments were delayed, elective procedures postponed, and healthcare resources were redirected toward managing the pandemic. This shift was largely driven by the high-risk profiles of PVD patients, many of whom also suffer from diabetes, hypertension, and heart disease conditions known to exacerbate the severity of SARS-CoV-2 infection [7,8].

These disruptions were compounded by changes in healthcare delivery and patient behavior. Social distancing policies, lockdowns, and widespread fear of infection led to reduced healthcare-seeking behavior, while hospital protocols prioritized emergency interventions and infection control over routine care [9-11]. Consequently, patients with advanced PVD may have experienced disease progression and worsening outcomes, regardless of COVID-19 infection status.

The pandemic also brought about lifestyle changes, reduced mobility, social isolation, and heightened psychological stress which may further influence the trajectory of chronic vascular diseases like PVD. Given PVD's impact on daily functioning and psychosocial well-being, it remains a critical question how these pandemic-induced lifestyle modifications have affected disease progression and outcomes in this vulnerable population.

Material & Methods

This observational study was conducted in the Department of General Surgery at D.Y. Patil School of Medicine, Nerul, Navi Mumbai, from 1st Jan 2021 to 31 Dec 2022. All patients meeting the inclusion criteria were enrolled in the study. The inclusion criteria consisted of patients who were RT-PCR positive for SARS-CoV-2, had a CT Severity Score (CT-SS) greater than 5, were RT-PCR negative but had a CORADS (Coronavirus Disease 2019 Reporting and Data System) score above 5, tested positive for COVID-19 antibodies, were admitted to the COVID-19 ward or ICU, or had a previous history of arterial disorders or peripheral vascular disease (PVD). Patients were excluded if they had a CORADS score less than 5, presented with trauma, or had a history of cerebrovascular accident (CVA). All patients who fulfilled the inclusion criteria during the study period were included; hence, no formal sample size calculation was performed.

For each participant, a detailed clinical assessment was carried out, which included history taking, physical examination, relevant laboratory and radiological investigations, and documentation of any operative procedures and postoperative complications. Following discharge, patients were monitored for one month, during which time they underwent follow-up evaluations including RT-PCR testing, CORADS [coronavirus disease 2019 (COVID-19) Reporting and Data System] scoring from chest CT scans, Doppler ultrasound (DVT scan) of both upper and lower limbs, CT angiography of bilateral lower limbs, and COVID-19 antibody testing.

Statistical analysis was performed using SPSS software version 21 and Microsoft Excel. Categorical variables were summarized using frequency tables, while continuous variables were presented as mean ± standard deviation (SD) or median with minimum and maximum values, depending on the distribution. Associations between categorical variables were assessed using the Chi-square test, with a p-value < 0.05 considered statistically significant.

Results & Discussion

The study included all patients visiting the department for diagnostic evaluation who were suspected of COVID-19 and tested positive on RT-PCR with symptoms and a CT severity score (CTSS) greater than 5, those who tested RT-PCR negative but had a CORADS score greater than 5, those with positive COVID-19 antibodies, patients admitted to the COVID ward or ICU, and those with a previous history of arterial disorders or peripheral vascular disease, until the desired sample size was achieved. The study was initiated after obtaining approval from the Institutional Scientific and Ethical Council. Written informed consent was obtained from all participants fulfilling the inclusion and exclusion criteriaThis study analyzed 20 confirmed COVID-19 patients presenting with vascular ischemia involving the abdomen and/or bilateral limbsover a period of 1 year. The parameters studied included age, gender, comorbidities, blood investigations, ICU stay duration, and radiological findings.

The patients ranged in age from 29 to 57 years, with a mean age of 55.10 ± 11.92 years. Age distribution showed that 2 (10%)of patients were between 29-40 years, 9(45%) were between 41-55 years, 7 (35%) were between 56-60 years, and 2 (10%) were older than 70 years. The study cohort was predominantly male, with 15 patients (75%) being male and 5 patients (25%) female. Acute symptoms lasting less than 15 days were present in 5 patients (25%), while 15 patients (75%) had no acute presentations.

Regarding comorbidities, [Table 1] 2(10%) of patients had diabetes mellitus alone, while 3(15%) had both diabetes and hypertension. Other combinations included diabetes with hypothyroidism 1(5%), diabetes with tuberculosis 1(5%), and a complex profile involving diabetes, hypertension, hypothyroidism, and ischemic heart disease 1(5%). Hypertension alone was present in 5(25%), and ischemic heart disease (IHD) alone in 1(5%) of patients.

Table 1. Comorbidities in study population N=20.

Comorbidity profile	n(%)
Diabetes Mellitus	2(10%)
Diabetes + Hypertension	3(15%)
Diabetes + Hypothyroidism	1(5%)
Diabetes + Tuberculosis	1(5%)
Diabetes + Hypertension + Hyperthyroidism + IHD	1(5%)
Hypertension	5(25%)
IHD	1(5%)

Blood investigations revealed abnormalities in a few cases, such as, [Table 2] C-reactive protein (CRP) was elevated in 1 patient (5%), D-dimer was elevated in 1 patient (5%), prothrombin time(PT) was prolonged in 1 patient (5%), total leukocyte count (TLC) was 22,000 in 1 patient (5%), while 16 patients (80%) had results within normal limits (WNL).

Table 2. Laboratory Investigations N=20.

Parameter	Abnormal n(%)	Normal n(%)
Elevated CRP	1(5%)	19(95%)
Elevated D dimer(583)	1(5%)	19(95%)
Elevated PT (2.08)	1(5%)	19(95%)
Elevated TLC (22000)	1(5%)	19(95%)

Radiological evaluations [Table 3] included AV Doppler in 4 patients (20%), AV Doppler of bilateral lower limbs in 2 patients (10%), AV Doppler of the right upper limb in 1 patient (5%), CECT with CT angiography in 1 patient (5%), CECT of abdomen and pelvis in 6 patients (30%), CT angiography in 5 patients (25%), and CT Angio A+P in 1 patient (5%).

Table 3. Radiological Investigations N=20.

Modality / Procedure	n(%)
AV Doppler (any site)	4(20%)
AV Doppler - Biliteral lower limb	2(10%)
AV Doppler - Right upper limb	1(5%)
CECT + CT Angiography	1(5%)
CECT abdomen & pelvis	6(30%)
CT Angiography	5(25%)
CT Angio A+P	1(5%)

Analysis of diagnosis patterns among patients with prior antithrombotic use showed that bilateral lower limb weakness with absent distal pulses, femoro-popliteal involvement, left great toe gangrene, peripheral vascular disease with right femoral embolectomy, right femoral artery thrombosis, right femoral vasculitis, right forehand gangrene, right lower limb gangrene, right lower limb PVD, right superficial artery disease, and SMA thrombosis were observed, with femoro-popliteal disease and right forehand gangrene being most frequent (each 10 i.e 50%), and SMA thrombosis seen in 5 patients i.e 25%.[Table 4]

Table 4. Distribution of Thrombus location N=20.

Thrombus Site	n(%)
Right Femoral Artery	3(15%)
Femoral Artery	2(10%)
Superior Mesenteric artery (SMA)	5(25%)
Right Popliteal artery	1(5%)
Common iliac artery	1(5%)
Superficial artery	1(5%)
Portal Vein	1(5%)
Portal / splenic vein + SMV	1(5%)
Right interior & posterior tibial artery	1(5%)
Right deep femoral artery	1(5%)
Right Ulnar & radial arteries	1(5%)
Multiple sites	1(5%)

The procedures performed in our study were as follows: exploratory laparotomy with resection and anastomosis 3 feet from the duodenojejunal (DJ) junction in 1 patient (5%), exploratory laparotomy with resection and anastomosis in 2 patients (10%), exploratory laparotomy with ileostomy in 3 patients (15%), femoropopliteal grafting in 1 patient (5%), conservative management in 4 patients (20%), ray's resection and anastomosis in 1 patient (5%), right below-knee amputation (BKA) in 2 patients (10%), right lower limb BKA in 1 patient (5%), and right femoral thromboembolectomy in 1 patient (5%) [Table 5].

Table 5. Surgical and Conservative management N=20.

Procedure / Management	n(%)
Exploratory laparotomy + resection & anastomosis (3 ft from dj)	1(5%)
Laparotomy + resection & anastomosis	2(10%)
Laparotomy + ileostomy	3(15%)
Femoro popliteal grafting	1(5%)
Right below knee amputation	3(15%)
Ray's amputation (great toe)	1(5%)
Resection anastomosis	1(5%)
Right femoral thromboembolectomy	1(5%)
Conservative management	4(20%)

In the present study, [Table 6] the distribution of vaccines among participants was as follows: Covaxin - 5 cases (25%) and Covishield - 12 cases (60%). Based on immunization status, 3 individuals (15%) had not received any vaccine dose, while 17 individuals (85%) had received two doses. Participants were also categorized based on prior use of antiplatelet therapy (thinners): 2 individuals (10%) were taking Ecosprin, while 18 individuals (90%) were not on any thinners.

Table 6. Vaccination and Antithrombotic Status N=20.

Variable	Category	n(%)
Vaccine	Covishield	12(60%)
	Covaxin	5(25%)
Vaccination Status	Two doses (Fully vaccinated)	17(85%)
	Unvaccinated	3(15%)
Prior Antithrombotic Use	Ecosprin	2(10%)
	None	18(90%)

A chi-square test evaluating the relationship between diagnosis and prior use of anti -thrombotic medications (blood thinners) revealed no statistically significant association (p = 0.154). [Table 7]

Table 7. Statistical Association of Clinical parameters

Variables or group compared	Chi square value	p-value
Diagnosis Vs Prior blood thinner	20.000	0.154
Procedure Vs Thrombus Level	235.556	0.031

Importantly, a statistically significant correlation was found between the procedure performed and the level of thrombus, with a p-value of 0.031, [Table 7] indicating that thrombus location played a decisive role in the clinical management strategy.

In a study conducted by Li et al. [12], the number of patients with peripheral vascular disease (PVD) was 15 in Group A and 50 in Group B. The mean age was 70.93 ± 10.18 years in Group A and 69.22 ± 9.67 years in Group B. Similarly, Smouldered et al. [13] reported that among 3,830 hospitalized SARS-CoV-2 patients, 50.5% were female, with a mean age of 63.1 ± 18.4 years; 50.7% were of non-White race, and 18.3% had PVD.

Kasiri et al. [14] reported that of the patients meeting inclusion criteria, 374 (61%) were men and 237 (39%) were women. Rastogi et al. [15] found that the most prevalent presenting symptoms were pain and gangrene, while common comorbidities included hypertension (51.3%), diabetes mellitus (31.9%), and hypercholesterolemia (17.6%). Furthermore, a study by Shinkar et al. involving 1,561 confirmed COVID-19 patients reported a 9.8% prevalence of diabetes.

Etkin et al. [16] reported a median D-dimer concentration of 2,673 ng/ml.They reported that hypertension (53%) and diabetes mellitus (35%) were identified as the most frequent pre-existing illnesses.6 patients (12%) had thrombi in multiple sites, while concomitant deep vein thrombosis (DVT) was observed in 8 patients (16%). Additionally, 22 patients (45%) presented with symptoms of acute arterial ischemia, which were subsequently confirmed to be associated with COVID-19. Similarly, Ali et al. concluded that the most common CT finding

in their cross-sectional study was ground-glass opacity (41.93%), most frequently with peripheral distribution (77.3%), bilateral involvement (45.5%), and a predominance in the lower lobes.

According to a study by Zhang et al., [17] most patients exhibited significantly elevated levels of D-dimer, fibrinogen, and fibrinogen degradation products (FDP). Prolonged prothrombin time was observed in four cases. Both D-dimer and FDP levels showed a gradual increase, correlating with the exacerbation of COVID-19.

Bhatnagar et al. [18] included 1,143 cases and 2,541 controls in their study and reported that the vaccine effectiveness (VE) of full vaccination with AZD1222/Covishield was 85%, while it was 71% with BBV152/Covaxin. The highest VE was observed between two doses administered 6-8 weeks apart, reaching 94% for AZD1222/Covishield and 93% for BBV152/Covaxin.

Murali et al. [19] studied 69,435 individuals, of whom 21,793 were over 45 years of age. The two-dose coverage of Covishield was 18% in the ≥18-year age group and 31% in the ≥45-year age group.

Klok et al. [20] found that patients with COVID-19 and acute respiratory distress syndrome (ARDS) had a significantly higher rate of pulmonary embolism (2.1% vs. 11.7%). Moreover, patients who developed thrombotic complications had more than a fivefold increase in all-cause mortality.

Conclusion

This study highlights the significant vascular complications associated with COVID-19, particularly among patients with pre-existing peripheral vascular disease (PVD) with hypertension and diabetes being the most common comorbidities. Superior mesenteric artery (SMA) thrombosis emerged as the most frequent thrombotic site, underscoring the abdominal vascular involvement seen in COVID-19.Vaccination may reduce the severity of COVID-19, it does not completely eliminate vascular complications in high-risk individuals with elevated inflammatory and coagulation markers in a minority of patients, consistent with COVID-19-associated coagulopathy described in previous studies.

The significant association between thrombus location and the type of surgical intervention performed emphasizes the importance of early imaging and prompt surgical decision-making in improving outcomes. However, pre-existing antithrombotic therapy alone may not be sufficient to prevent COVID-19-related thrombotic events. Overall, these findings reinforce the critical need for aggressive management strategies-including surgery where indicated-to prevent limb loss and mortality in COVID-19 patients with vascular involvement.

Limitation of our present study include smaller sample size, limited flow of patients, short follow up time and restricted to a single centre study. A larger multicentric studies with longer follow-up are warranted to better define the role of vaccination status, antithrombotic therapy and early intervention in mitigating vascular complications and improving patient outcomes.

Human Subjects

- Yes - Human participants or tissue were used in this study.
- IRB/Committee: D Y PATIL MEDICAL COLLEGE & HOSPITAL
- Approval #: DYP/IECBH/2021/178

Animal Subjects

No - Animal subjects or tissue were not used in this study

Conflicts of Interest

- No - There are no payments, etc. to disclose.
- No - There are no financial relationships to disclose.
- No - There are no intellectual property conflicts to disclose.
- No - There are no other relationships to disclose.

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