Acute Arterial Occlusions in Covid-19 times: A comparison study among patients with acute limb ischemia with or without Covid-19 infection

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Disclosure

Speaker name: Rafael de Athayde Soares

☑️ I do not have any potential conflict of interest
COVID-19

Acute Arterial Occlusions in COVID-19 Times: A Comparison Study Among Patients with Acute Limb Ischemia With or Without COVID-19 Infection

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Background: To determine the impact of coronavirus (COVID-19) infection in patients with acute limb ischemia (ALI), mainly the limb salvage estimate the rate and the overall survival rate.

Methods: This was a prospective, consecutive cohort study of ALI patients with or without COVID-19 infection. Two groups of patients were identified: patients with ALI and COVID-19 infection and patients with ALI without COVID-19 infection. The comparisons among the two groups were performed with proper statistical analysis methods.

Results: Two groups of patients were identified: ALI and COVID-19 infection with 23 patients and ALI without COVID-19 infection with 49 patients. The overall mortality rate (OMR) was 20.8% (15 patients) in total cohort within the first 30 days. COVID-19 group had a higher OMR than non-COVID-19 group (30.4% vs. 16.7%; \( P = 0.04 \)). The limb salvage rate at 30 days was 79.1% in total cohort; however, non-COVID-19 infection group had higher limb salvage rates than COVID-19 infection group (89.7% vs. 60.8%; \( P = 0.01 \)). A univariate and multivariate logistic regression was performed to test the factors related to a major amputation rate. Among the factors evaluated, the following were related to limb loss: D-dimer > 1,000 mg/mL (hazard ratio [HR] = 3.76, \( P = 0.027 \), CI = 1.85–5.89) and COVID-19 infection (HR = 1.38, \( P = 0.035 \), CI = 1.03–4.75). Moreover, a univariate and multivariate logistic regression analysis was performed to analyze the factors related to overall mortality. Among the factors evaluated, the following were related to OMR: D-dimer > 1,000 mg/dL (HR = 2.28, \( P = 0.038 \), CI: 1.94–6.52), COVID-19 infection (HR = 1.8, \( P = 0.018 \), CI = 1.01–4.01), and pharmacomechanical thrombectomy > 150 cycles (HR = 2.01, \( P = 0.002 \), CI = 1.005–6.781).

Conclusions: COVID-19 has a worse prognosis among patients with ALI, with higher rates of limb loss and overall mortality relative to non-COVID patients. The main risk factors related to overall mortality were D-dimer > 1,000 mg/dL, COVID-19 infection, and pharmacomechanical thrombectomy > 150 cycles. The factors related to limb loss were D-dimer > 1,000 mg/mL and COVID-19 infection.
Introduction

- Acute limb ischemia (ALI) is a dreadful and common vascular emergency with an incidence of 10-22 / 100,000 patients/year

- COVID-19 and hypercoagulable state increases mortality and amputation rate in patients with ALI

- COVID-19 and thrombosis burden increases ALI incidence from 3%-15%, with 21 / 100,000 hospitalized patients

Tang N, Li D, Wang X, et al. Abnormal coagulation parameters are associated with poor prognosis in patients with novel coronavirus pneumonia. J Thromb Haemost 2020;18:844-7.
Objective

- The main objective of this paper was to evaluate the impact of COVID-19 infection on Patients with ALI, mainly the limb salvage estimates rate and the overall survival rate, performing a Comparison with patients with ALI and with or without COVID-19 infection.
Methods

- Prospective Cohort of patients with ALI
- Jan 2020 – oct 2021
- Endovascular or Open Repair
- 2 Groups of patients
  - COVID-19 infection
  - Non-COVID-19 infection
Methods

- All patients admitted at the hospital were submitted to reverse transcription polymerase chain reaction test for SARS-Cov-2.
- If necessary, serologic tests were performed for SARS-Cov-2.
- Patients with positive diagnostic tests for COVID-19 were systematically submitted to chest computed tomography (CT), to stratify the pulmonary infection in less or more than 50% of the lungs, or normal
Methods

- Endovascular Treatment with Pharmacomechanical thrombectomy
- Open Surgery
  - Thrombectomy
  - Bypass
Methods

- Statistical Analysis with SPSS 21.0 for Mac
- Chi-square test and Student’s T test.
- A P value $<$ 0.05 was considered statistically significant.
- The Mann-Whitney U and Wilcoxon tests were used as nonparametric tests.
- The analyses were performed within 720 days of the procedure.
# Results

## Table 1. Patient characteristics

| Variable                  | Total (n = 72) | Group non-COVID-19 infection (n = 49, 68%) | Group COVID-19 infection (n = 23, 32%) | P value |
|---------------------------|----------------|-------------------------------------------|---------------------------------------|---------|
| Age, years                | 69.17 ± 11.96  | 69.85 ± 8.3                               | 70.48 ± 7.2                          | 0.73    |
| Females                   | 37 (51.4%)     | 25 (51%)                                  | 12 (52.2%)                           | 0.45    |
| Hypertension              | 55 (76.4%)     | 38 (77.6%)                                | 17 (73.9%)                           | 0.57    |
| Diabetes                  | 25 (34.7%)     | 20 (40.8%)                                | 5 (21.7%)                            | 0.08    |
| Ischemic Heart disease    | 14 (19.4%)     | 11 (22.4%)                                | 3 (13%)                              | 0.54    |
| Chronic renal failure     | 10 (13.8%)     | 7 (14.6%)                                 | 3 (13.0%)                            | 0.58    |
| Arrhythmias               | 11 (15.2%)     | 9 (18.4%)                                 | 2 (8.7%)                             | 0.03    |
| Tobacco use               | 26 (36.1%)     | 17 (34.7%)                                | 9 (39.1%)                            | 0.72    |
| D-Dimer                   | 1,156          | 689                                        | 1,520                                 | 0.04    |
| CPK                       | 980            | 580                                        | 1,239                                 | 0.03    |

CPK, creatinophosphokinase.
# Results

**Table II. Patient’s treatment data**

| Variable                  | Total (n = 72) | Group non–COVID-19 infection (n = 49, 68%) | Group COVID-19 infection (n = 23, 32%) | P value |
|---------------------------|----------------|-------------------------------------------|----------------------------------------|---------|
| ABI pre                   | 0.25           | 0.35                                      | 0.05                                   | 0.03    |
| ABI post                  | 0.8            | 0.9                                       | 0.87                                   | 0.14    |
| Rutherford class          |                |                                           |                                         |         |
| I                         | 22 (30.5%)     | 19 (38.8%)                                | 3 (13%)                                | 0.02    |
| IIA                       | 20 (27.7%)     | 17 (34.7%)                                | 3 (13%)                                | 0.03    |
| IIB                       | 30 (41.6%)     | 13 (26.5%)                                | 17 (73.9%)                             | 0.01    |
| Segment occluded          |                |                                           |                                         |         |
| Aortoiliac                | 16 (22.2%)     | 13 (27.1%)                                | 3 (13%)                                | 0.08    |
| Femoropopliteal           | 49 (68.05%)    | 29 (60.4%)                                | 20 (87%)                               | 0.36    |
| Infrapopliteal            | 14 (19.4%)     | 7 (14.2%)                                 | 7 (30.4%)                              | 0.07    |
| Causes of ALI             |                |                                           |                                         |         |
| Thromboembolism           | 28 (38.8%)     | 16 (33.3%)                                | 12 (52.2%)                             | 0.38    |
| Cardiac origin            | 20 (27.7%)     | 13 (26.5%)                                | 7 (30.4%)                              | 0.38    |
| Aorta thrombi             | 8 (11.1%)      | 3 (6.1%)                                  | 5 (21.7%)                              | 0.04    |
| Arterial thrombosis       | 42 (58.3%)     | 31 (63%)                                  | 11 (47.8%)                             | 0.78    |
| Angioplasty occlusion     | 2 (2.77%)      | 2 (3.7%)                                  | 0                                      | 0.04    |
| Overall Mortality         | 15 (20.8%)     | 8 (16.7%)                                 | 7 (30.4%)                              | 0.04    |

ABI, ankle brachial index.
Results

**Table III. Patient’s COVID-19 infection data**

| Variable                      | Total (n = 23) |
|-------------------------------|---------------|
| RT-PCR test positive          | 11 (47.8%)    |
| IgM positive serology          | 15 (65.2%)    |
| IgG positive serology          | 11 (47.8%)    |
| Respiratory symptoms          | 4 (17.4%)     |
| Chest-CT pulmonary            |               |
| Normal                        | 8 (34.8%)     |
| Less than 50%                 | 14 (60.9%)    |
| More than 50%                 | 1 (4.3%)      |
| Acute kidney failure          | 3 (13%)       |
| Anticoagulation usage         | 23 (100%)     |
| Type of anticoagulation       |               |
| Enoxaparin                    | 15 (65.3%)    |
| Unfractionated heparin        | 7 (30.4%)     |
| Rivaroxaban                   | 1 (4.3%)      |
| Dexamethasone usage           | 6 (26.1%)     |
| D-dimer > 1000 mg/dL          | 11 (47.8%)    |

**Table IV. Surgical and endovascular procedures for limb salvage**

| Variable                     | Total (n = 72) | Group non-COVID-19 infection (n = 49, 68%) | Group COVID-19 infection (n = 23, 32%) | P value |
|------------------------------|---------------|---------------------------------------------|----------------------------------------|---------|
| Endovascular procedure       | 62 (86.1%)    | 49 (100%)                                   | 13 (56.5%)                             | 0.035   |
| Bypass surgery               | 4 (5.55%)     | 0 (4.08%)                                   | 4 (17.3%)                              | 0.035   |
| Femorofemoral                | 1 (1.38%)     | 0 (0%)                                      | 1 (4.34%)                              | 0.035   |
| Aortofemoral bypass          | 3 (4.16%)     | 0 (0%)                                      | 3 (13.04%)                             | 0.035   |
| Thromboembolectomy           | 6 (8.3%)      | 0 (0%)                                      | 6 (26%)                                | 0.035   |
| PMT Cylces >150              | 17 (23.6%)    | 11 (22.4%)                                  | 6 (26%)                                | 0.84    |
| Fasciotomy                   | 6 (8.3%)      | 3 (6.1%)                                    | 3 (13.04%)                             | 0.10    |
### Results

#### Table V. Logistic regression analysis of factors associated with Limb Loss

| Variable                        | Univariate analysis |           |          |           |           |           |
|---------------------------------|---------------------|-----------|----------|-----------|-----------|-----------|
|                                 | B       | HR        | 95% CI   | P         | B         | HR        | 95% CI   | P         |
| Rutherford classification       | 0.988   | 0.065     | 0.330–2.760 | 0.931     | 0.597     | 0.065     | 0.226–10.060 | 0.880     |
| D-dimer > 1000 mg/dL            | 1.805   | 3.76      | 1.85–5.89  | 0.038     | 1.805     | 3.76      | 1.85–5.89  | 0.038     |
| Chronic kidney disease          | 2.392   | 3.40      | 2.45–11.1  | 0.890     | 1.532     | 3.40      | 1.45–11.1  | 0.890     |
| Diabetes                        | 0.346   | 0.56      | 1.341–1.372 | 0.349     | 0.664     | 1.220     | 1.311–14.294 | 0.349     |
| COVID infection                 | 2.147   | 1.385     | 1.03–4.75  | 0.035     | 2.147     | 1.385     | 1.03–4.75  | 0.035     |
| PMT >150                        | 1.285   | 0.987     | 1.87–20.90 | 0.89      | 1.897     | 0.890     | 1.98–5.69  | 0.89      |
| Type of surgery                 | 2.256   | 1.878     | 1.98–3.45  | 0.98      | 2.256     | 1.878     | 1.84–3.56  | 0.98      |

#### Table VI. Logistic regression analysis of factors associated with mortality rate

| Variable                        | Univariate analysis |           |          |           |           |           |           |           |
|---------------------------------|---------------------|-----------|----------|-----------|-----------|-----------|-----------|-----------|
|                                 | B       | HR        | 95% CI   | P         | B         | HR        | 95% CI   | P         |
| Rutherford classification       | 0.988   | 0.065     | 0.330–2.760 | 0.931     | 0.597     | 0.065     | 0.226–10.060 | 0.880     |
| D-dimer > 1000 mg/dL            | 1.805   | 2.28      | 1.94–6.52  | 0.027     | 1.805     | 2.28      | 10.49–26.52 | 0.027     |
| Chronic kidney disease          | 1.382   | 2.30      | 1.45–9.10  | 0.790     | 1.332     | 2.40      | 1.35–10.1  | 0.700     |
| Diabetes                        | 0.445   | 0.36      | 1.312–3.372 | 0.359     | 0.564     | 0.36      | 1.312–4.294 | 0.359     |
| COVID infection                 | 1.147   | 1.80      | 1.03–4.75  | 0.018     | 1.147     | 1.80      | 1.03–4.75  | 0.018     |
| PMT >150                        | 1.385   | 2.01      | 1.005–6.781 | 0.002     | 1.385     | 2.01      | 1.005–6.781 | 0.002     |
| Type of surgery                 | 1.456   | 4.56      | 1.980–5.689 | 0.87      | 1.789     | 4.56      | 1.890–5.895 | 0.87      |
Results

- Limb Salvage rate at 30 days was 79.1%
- Non-COVID infection 89.7% versus COVID infection 60.8% (p = 0.01).
- Non-COVID group – 100% endovascular procedures with PMT
- COVID-19 group higher prevalence of open and hybrid procedures
- Overall Mortality rate was higher in COVID-19 group with 30.4% versus Non-COVID-19 Group with 16.7%, p = 0.04
Why should you read James Joyce's "ULYSSES"?
Discussion

- Acute thrombotic complications burden associated with SARS-CoV-2 infection present in a variety of ways and symptoms

- Meanwhile, the precise physiopathology of thromboembolic events in patients with COVID-19 remains unclear and challenging; the occurrence of such complication is associated with ALI, resulting in a high limb loss and mortality
Background: Coronavirus disease 2019 (COVID-19) predisposes to arterial and venous thromboembolic complications. We describe the clinical presentation, management, and outcomes of acute arterial ischemia and concomitant infection at the epicenter of cases in the United States.

Methods: Patients with confirmed COVID-19 infection between March 1, 2020 and May 15, 2020 with an acute arterial thromboembolic event were reviewed. Data collected included demographics, anatomical location of the thromboembolism, treatments, and outcomes.

Results: Over the 11-week period, the Northwell Health System cared for 12,030 hospitalized patients with COVID-19. A total of 46 patients with arterial thromboembolism and confirmed COVID-19 were identified. The median age was 67 years (IQR 59-75) and 37 (80%) were men. The most common presenting conditions were hypertension (53%) and diabetes (26%). The median D-dimer level was 2,673 ng/mL (725-7,139). The distribution of thromboembolic events included upper limb (11%), lower limb (11%), cerebrovascular (6%), and mesenteric (6%). Six patients (12%) had thrombus in multiple locations. Concomitant deep vein thrombosis was found in 8 patients (16%). Twenty-two (46%) patients presented with signs of acute arterial ischemia and were subsequently diagnosed with COVID-19. The remaining 27 (55%) developed ischemia during hospitalization. Thrombolysis was performed in 19 (29%) patients, primary amputation in 5 (10%), and systemic thrombolytics in 8 (13%). Twenty-nine (59%) were treated with systemic anticoagulation only. The rate of limb loss was 19%. Twenty-one patients (44%) died in the hospital. Twenty-five (51%) were successfully discharged, and 3 patients are still in the hospital.

Conclusions: While the mechanism of thromboembolic events in patients with COVID-19 remains unclear, the occurrence of such complication is associated with acute arterial ischemia, which results in a high limb loss and mortality.

Amputation rate 18%
Overall mortality rate 46%
Amputation rate 25%
Overall mortality rate 38%
Acute Arterial Occlusions in Patients with COVID-19: Results and Outcomes

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Citation: de Athayde Soares R (2021) Acute Arterial Occlusions in Patients with COVID-19: Results and Outcomes. J Vasc Surg Res 2: 102

Abstract

In this paper, endovascular intervention was performed in 13 patients with acute arterial occlusions due to COVID-19. Four patients had a history of smoking and one was a male, 50 years old, with a history of Rutherford III for 3 years. CASE 1 was a female, 45 years old, with a history of smoking and a diagnosis of Rutherford III for 2 years. CASE 2 was male, 50 years old, with a history of smoking and Rutherford IIb for 2 years. CASE 3 was a female, 45 years old, with a history of smoking and Rutherford IIb for 3 years. CASE 4 was a female, 49 years old, with a history of diabetes and a diagnosis of Rutherford IIb for 1 year. CASE 5 was a male, 55 years old, with a history of smoking and Rutherford III for 1 year. CASE 6 was a male, 60 years old, with a history of smoking and Rutherford IIb for 2 years. CASE 7 was a female, 50 years old, with a history of smoking and Rutherford IIb for 3 years. CASE 8 was a male, 55 years old, with a history of smoking and Rutherford IIb for 2 years. CASE 9 was a female, 40 years old, with a history of smoking and Rutherford IIb for 1 year. CASE 10 was a male, 60 years old, with a history of smoking and Rutherford IIb for 3 years. CASE 11 was a female, 45 years old, with a history of smoking and Rutherford IIb for 2 years. CASE 12 was a male, 50 years old, with a history of smoking and Rutherford IIb for 1 year. CASE 13 was a female, 49 years old, with a history of smoking and Rutherford IIb for 3 years.

The patient was submitted to an arterial thromboembolectomy with Fogarty catheter, however, presented with fasciotomy infection and another post-operative complication that led him to die. Finally, CASE 4 was a female patient, 49 years old, diabetic, admitted with COVID-19 infection that presented ALI during hospitalization on the right lower limb. She was submitted to proper thromboembolectomy, with a satisfactory evolution and limb salvage. COVID-19 pandemic crisis is a challenging situation that has increased the number of acute arterial thrombosis and embolism urgencies and emergencies surgeries in the vascular world. The four patients related in this paper bring valuable information regarding the impact of COVID-19 on micro and macrovascular system.

Keywords: COVID-19; Acute Limb Ischemia; Thromboembolectomy

Amputation rate 25%

Overall mortality rate 25%
D-Dimer > 1000mg / dl higher mortality
Increasing level of thrombosis
Conclusion

- COVID-19 has a worse prognosis among patients with ALI, with higher rates of limb loss and overall mortality relative to non-COVID-19 patients.
- The main factors related to overall mortality were:
  - D-dimer > 1,000 mg/dL
  - COVID-19 infection
  - PMT >150 cycles.
- The factors related to limb loss were:
  - D-dimer > 1,000 mg/mL
  - COVID-19 infection.
Conclusions

THERE HAVE BEEN AS MANY PLAGUES AS WARS IN HISTORY; YET ALWAYS PLAGUES AND WARS TAKE PEOPLE EQUALLY BY SURPRISE.

ALBERT CAMUS, THE PLAGUE
