

## **Plantar Vein Thrombosis in a Patient with COVID-19**

### **Case Report**

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Plantar thrombophlebitis is a rare abnormality with few cases reported in the literature. Coexistence with severe acute respiratory syndrome coronavirus 2 infection increases its relevance. The disease is generally classified as idiopathic, and it is suggested that it is attributed to conditions that lead to hypercoagulability. We present the case of a 68-year-old female patient with thrombosis of the lateral plantar veins and a diagnosis of coronavirus disease of 2019. The plantar vein thrombosis diagnosis was made by means of Doppler ultrasonography and magnetic resonance imaging. Severe acute respiratory syndrome coronavirus 2 infection was suspected per clinical information and confirmed with reverse-transcriptase polymerase chain reaction technique. Treatment was successful using rivaroxaban and nonsteroidal antiinflammatory drugs. (J Am Podiatr Med Assoc 113(2), 2023)

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Plantar thrombophlebitis (PT) is a rare disease with few cases described in the literature.<sup>1-3</sup> The presence of nonspecific pain, primarily in the plantar arch, points to a large differential diagnoses, which includes plantar fasciitis.<sup>2</sup> Ultrasonography (USG) and magnetic resonance imaging (MRI) are the main complementary tests.<sup>1-4</sup> The lateral plantar vein is affected in 96% of PT cases, the medial vein is affected in 41%, and the extension to the leg's deep venous system is frequent (27%).<sup>1</sup> The pathogenesis is uncertain, but it can be related to multiple causes such as genetic alterations in the coagulation cascade, trauma, paraneoplastic syndrome, excessive physical activity, and previous surgery.<sup>3</sup> These etiologies can cause changes in one or more of the Virchow triad factors (damage to the endothelium, state of hypercoagulability, venous stasis).<sup>2</sup>

In coronavirus disease of 2019 (COVID-19), hypercoagulability occurs through an exaggerated or hyperinflammatory response of the immune system, resulting in tissue damage, damage to the

endothelial barrier, and activation of procoagulant factors.<sup>5</sup> Lower limb vasculitis and dermatologic manifestations of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection have been documented during this past year.<sup>6,7</sup> Considering the rarity of the pathology and the relevance of the case in the face of the pandemic period, we present the case of a patient with plantar thrombophlebitis coexisting with COVID-19 infection.

### **Case Report**

This case report was reviewed and approved by the relevant institutional review board. A 68-year-old female patient presented with headache, nausea, and myalgia during the COVID-19 pandemic and was diagnosed with confirmation of a SARS-CoV 2 infection after a reverse-transcriptase polymerase chain reaction test. Treatment with symptomatic medications led to an overall improvement of the symptoms. According to the COVID-19 protocol, the patient had a D-dimer test, with the result of 807 ng/ml fibrinogen-equivalent units (FEU) at the time of diagnosis of the infection and a subsequent value of 679 ng/ml FEU 2 days later. (The adopted cut-off, which is correlated with a high negative predictive value, is 500 ng/ml FEU.) One week later, she presented with pulsatile left lateral plantar pain,

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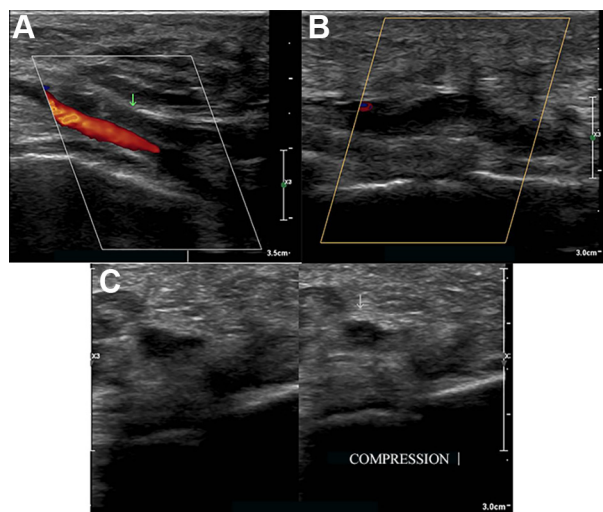
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associated with edema and intermittent flushing. There was no history of recent trauma. There was also edema in the ankle region and paresthesias in the plantar foot. The patient was able to ambulate without assistance but with difficulty because of the pain. Before this, the patient was very active in aerobic exercise and resistance training. The overall examination, other than the chief complaint, and bilateral pes planus, was unremarkable. The pes planus had been a long-standing issue and had not caused any past problems.

The patient had no history of thromboembolic events. Her current and past medications were not associated with hypercoagulable side effects. There was no history of smoking; recent, prolonged immobilization; or a family history of clotting. The history of previous surgery included a reduction mammoplasty performed years before this episode. Comorbidities included hypothyroidism and hypercholesterolemia treated with levothyroxine 8.8  $\mu\text{g}$  daily and atorvastatin 10 mg daily. The patient's body mass index was 26.56  $\text{kg}/\text{m}^2$ .

The patient underwent imaging tests for diagnostic clarification. Doppler USG of the venous system of the left lower limb showed noncompressibility of the lateral plantar veins, a hyperechogenic content within the vessel, and a lack of normal flow seen on color Doppler imaging, all suggesting venous thrombosis (Fig. 1). The rest of the involved segments (femoral to medial plantar



**Figure 1.** Color Doppler ultrasonography of the lateral plantar veins. (A and B) Longitudinal images showing absence of blood flow. Arrowheads show the hyperechogenic content inside. (C) Axial image showing absence of sensitivity of the lateral plantar veins.

veins) did not show any abnormality. A subsequent magnetic resonance imaging (MRI) scan of the foot and ankle, on the same date, confirmed the suspicion with signs of thrombosis of the lateral plantar veins, characterized by ectasia, flaws in the filling, and swelling of adjacent soft tissues along the ankle and midfoot (Fig. 2). No other abnormalities were present.

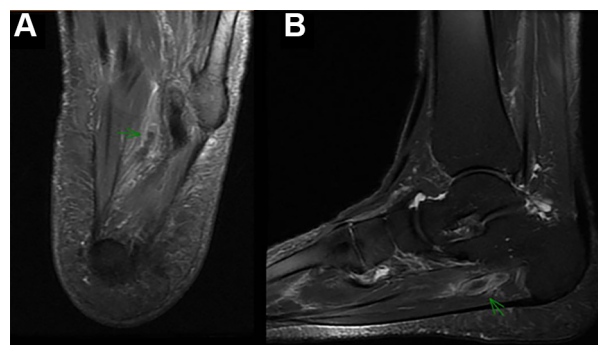
Treatment included rest, nonsteroidal anti-inflammatory drugs, and rivaroxaban. Rivaroxaban initially was dosed at 15 mg every 12 hours for 1 month, then 10 mg every 12 hours for the remainder of treatment. Follow-up Doppler USG was performed 4 weeks after the onset of pain, and there was obvious recanalization of the lateral plantar vein, compressibility, and normal flow on color Doppler (Fig. 3).

By 8 weeks, most of the major signs and symptoms resolved, with only mild residual plantar paresthesias. The patient was evaluated 8 months later with complete resolution of all symptoms.

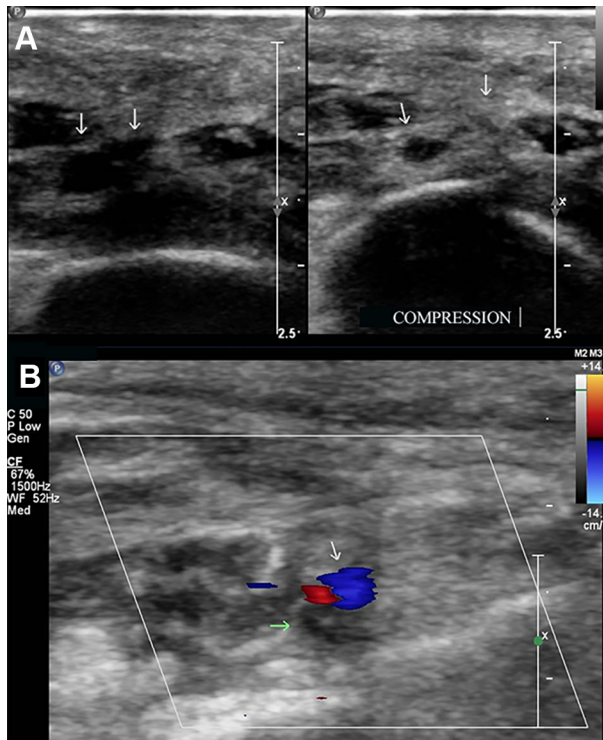
## Discussion

The lateral and medial plantar veins follow the course of their corresponding arteries in the plantar region. Proximally, they deepen, close to the abductor hallucis muscle, and become a single vessel. Then, adjacent to the medial malleolus, they converge to the branches of the great and small saphenous veins to eventually form the posterior tibial vein.<sup>3</sup>

Compromise of the plantar portion of this venous system is rare, and thrombophlebitis should be considered as a differential diagnosis in patients with inflammatory plantar or dorsal symptoms in a potential state of hypercoagulability,<sup>5,8,9</sup> as is seen



**Figure 2.** Fast spin-echo magnetic resonance imaging axial (A) and sagittal (B) images. T2-weighted images with fat saturation demonstrate ectasia, adjacent edema, and filling failures.



**Figure 3.** Color Doppler ultrasonography shows recanalization of another lateral plantar vein and compressibility (A), and the blood flow is shown in the color Doppler (B).

in infections by SARS-CoV 2. Coronavirus disease of 2019 tends to reach the extremity of the limbs in several ways. As an example, we have cutaneous manifestations (areas of erythema and edema adjacent to vesicles and pustules, eg, COVID toes), erythematous rash, urticaria,<sup>10</sup> and neurologic<sup>9</sup> and vascular manifestations (eg, ischemia, gangrene, thromboembolism).<sup>10</sup>

In general, SARS-CoV-2 directly attacks endothelial cells by penetrating through the angiotensin-converting enzyme 2 receptor, with consequent loss of barrier function and increased capillary permeability. The inflammatory response is characterized by the activation of T cells, monocytes, neutrophils, macrophages, and platelets, increasing the release of proinflammatory cytokines (interleukin [IL]-1, IL-6, IL-10) and tumor necrosis factor- $\alpha$ , a tissue factor derived from monocytes and an inhibitor of plasminogen activator type 1. As a result, we have a thrombus formation characterized by neutrophil extracellular traps, fibrin, and platelets.<sup>5</sup>

Ultrasonographic findings include lack of flow on Doppler,<sup>4</sup> enlarged and hypoechoic venous structures in the transversal and longitudinal planes,<sup>8</sup> ectasia,<sup>2,8</sup> and loss of vascular compressibility.<sup>2</sup> On

MRI, we were able to exclude possible other causes of plantar pain, in addition to possibly finding venous filling failure,<sup>4</sup> edema,<sup>2</sup> and perivenular enhancement.<sup>2</sup> The changes found in our example were consistent with the usual ones. Ultrasonography, although examiner-dependent, is a safe examination and has assisted with a definitive diagnosis and with treatment selection and monitoring.

A consistent finding in patients with COVID-19 is the association between severity/mortality and elevation of markers such as D-dimer and fibrinogen degradation products, both markers of thrombotic phenomena.<sup>5,8</sup> Values above 1,000 ng/mL at hospital admission of adult patients indicate a 20 times greater chance of dying because of infection when compared to values below this reference.<sup>9</sup> Orthopedic surgeons should be aware that, in addition to PT, there is a possibility of thrombosis at proximal sites and other disorders intrinsic to COVID-19, which can aggravate the patient's condition.

Despite being scarce, data in the literature suggest that not using anticoagulants is associated with thrombosis progression to the leg veins.<sup>1</sup> Although there is not sufficient reference to determine the duration and intensity (prophylactic or therapeutic use),<sup>1</sup> in this case, our decision was based on the literature related to PT and the case series of COVID-19.

## Conclusions

To our knowledge, this is the first case report of PT related to SARS-CoV-2. It is essential to recognize a plantar vein thrombosis in a patient with plantar pain and relate this abnormality attributable to COVID-19. Therefore, differently from what occurred in the case described, it is possible that, based on a PT, the diagnosis of COVID-19 be suspected, especially in patients without other risk factors.

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**Conflict of Interest:** None reported.

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