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Abdominal Aortic Thrombosis Complicating COVID-19 Pneumonia

Coronavirus disease 2019 (COVID-19) is a major health issue around the world with many clinical facets including vascular ones. In this regard, the interesting case reported by Giacomelli and collaborators invites to discuss some aspects of acute arterial thrombosis in course of COVID-19 pneumonia.¹ Blood hypercoagulability, a typical feature of this viral infection, can cause both venous and arterial thromboses, as recently described, more commonly involving medium-sized arteries (supra-aortic trunks, cerebral arteries).² The case of an acute thrombosis on aortic graft represents an extreme complication, whose pathophysiology carries interesting points of discussion.^{3,4} At distance from surgery, the walls of an aortobisiliac graft, encased in a dense connective tissue, miss any native elasticity; similarly, the iliac arteries become more stiff because of aging and atherosclerosis, progressively reducing their caliber. The distal aorta decreases its compliance and its flow slows, meeting greater resistances and being counteracted by reverse rebound currents generated by its impact on the rigid walls of the aortic bifurcation; when an enough high Reynolds number is reached, the flow becomes turbulent. This altered hemodynamics predisposes to thrombosis, together with a blood hypercoagulable state and other cofactors, such as arterial hypotension, tachycardia, and increased blood viscosity secondary to dehydration. Therefore, we think likely that an acute thrombosis spreads from the iliac branches retrograde to the entire aortic graft. This pathology has more severe circulatory consequences, if abruptly arises in a system without an adequate preformed network of collaterals, as after an open aortic repair suturing the lumbar arteries and often the inferior mesenteric trunk. Another possible expression of this pathology concerns thrombosis of the abdominal aorta, sometimes incidentally discovered at an early stage of mural thrombus, typically adherent to the posterior wall of the middle-distal abdominal aorta. Here, the blood flow reduces its kinetic energy, mainly in its posteroexternal lines, not adequately sustained by collateral effluent streams toward aortic branches, nor enlivened by rebound currents coming from the downstream rigid aortic bifurcation. This mechanics contributes to shape the thrombus like a

«butterfly», leaning against the aortic wall, with a thin central body and two large wings (Fig. 1). On CT, when fresh, it can be distinguished from the aortic wall, while MRI can demonstrate a high signal in T1-weighted scans for the presence of paramagnetic methemoglobin.^{5,6} Although asymptomatic at an early stage, the thrombus carries an important risk of peripheral embolization, of «saddle» embolus to the aortic bifurcation, or of progressive spreading inside the aorta and one of its branches.⁷ In presence of an aortic graft or an endoprosthesis, this complication can progress until to completely obstruct the aortic lumen. In its pathogenesis, we also remark the important role of atherosclerosis, which can complicate with rupture of a vulnerable plaque, ulceration of the surrounding intima, directly leading to a mural thrombosis. This pathological sequence fits well with the abdominal aorta histology, while, in its thoracic segment, provided of more loose connective elastic tissue, would most likely develop into an aortic dissection because of the strong energy action of systolic waves, whose high systolic pressure is not completely absorbed by the aortic walls affected by a reduced elasticity.^{8,9} Therefore, in COVID-19 patients, the increased risk of venous and even arterial thromboses indicates an adequate medical prophylaxis and a careful monitoring of the entire peripheral circulatory system, mainly in case of previous vascular surgery or of coexisting arterial diseases. Today emergent, COVID-19 alerts to enlarge the concept of acute abdominal aortic syndrome, encompassing, besides the more frequent ruptured or fissured aneurysms, also thromboses, which can follow in addition any open aortic surgery or endovascular procedure, or complicate further different conditions, such as aortic aneurysm, paraneoplastic, nephrotic, and antiphospholipid syndromes, Takayasu arteritis, cisplatin chemotherapy, cocaine intake, thrombocytopenia, inflammatory bowel diseases, acute pancreatitis, and abdominal abscess.¹⁰ The possible various manifestations of COVID-19 affect the therapeutic choices: a small and recent abdominal aortic thrombus can be at first approached with a pharmacological treatment, while a more organized and extended thrombosis can indicate a surgical treatment, open or endovascular.^{5,6}

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Fig. 1. Imaging from a 66-year-old Italian male patient affected by severe COVID-19: **(A)** diffuse reticulation with crazy paving and dorsal ground glass opacities are well noticeable in both lungs on CT axial scan (the thoracic aorta is normal); **(B)** CT-angiography axial scan reveals a not obstructive parietal thrombus adherent to the posterior wall of

the middle abdominal aorta, with a typical «butterfly» aspect (*arrow*). Imaging from another 72-year-old Italian male patient with severe COVID-19: **(C)** CT-angiography shows a similar not obstructive thrombus adherent to the posterior wall of the infrarenal abdominal aorta, which takes a triangular shape in coronal scan (*arrow*).

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