



# OCCURRENCE OF STROKE IN COVID-19

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## Background

Patients with COVID-19 may exhibit a wide array of neurologic manifestations, including stroke. In some cases, stroke has been the presenting or predominant manifestation. The frequency of stroke in association with COVID-19 has varied greatly in previous reports, almost certainly reflecting the intensity with which neurologic abnormalities have been evaluated. The great majority of strokes reported in association with COVID-19 have been thought to be ischemic.

## Methods

Review of literature with search term COVID PLUS stroke, cardiovascular accident, neurologic, vascular, complications thru recent publications.

## Results

Seven studies to date with detailed neurologic information (*see* Table 1)

## Discussion

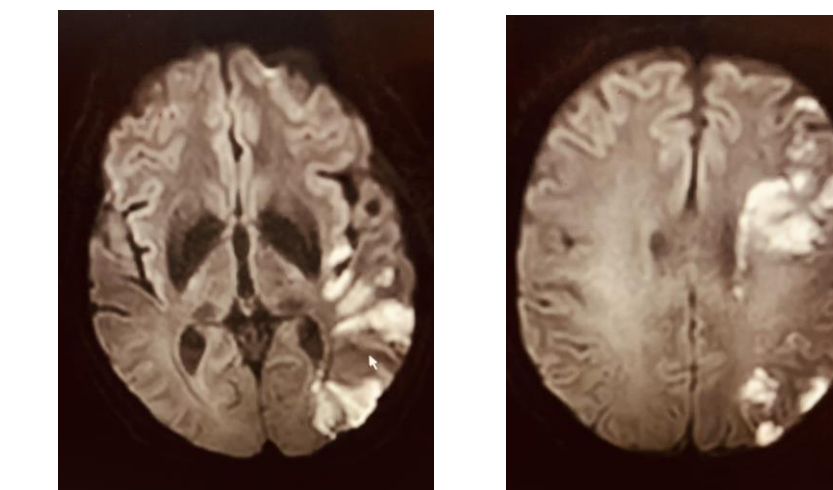
COVID-19 causes a generalized hypercoagulable state, and arterial thromboses have been recognized in other organs, as well, involving pulmonary, mesenteric and coronary arteries. Coronavirus infection causes an intense release of cytokines with widespread activation of the coagulation cascade. In addition, SARS-CoV-2 attaches to ACE 2 receptors on endothelial surfaces via the S (spike) protein and invades, causing a localized inflammatory response, with a resulting increase in local thrombotic activity. Antiphospholipid antibodies are sometimes present. New data suggest possible role of alpha-defensin level in creation and prevention of disintegration of blood clots. To date, however, reports of neurologic disease are based on case series, so there is no way, at present, to calculate the frequency of neurologic complications of COVID-19. Thus, a systematic, prospective study focusing on neurologic examination supplemented by MRI in hospitalized patients would answer the question of the incidence of this complication. But logistical problems, including patients' need for ICU care and concern for contagion resulting from sending patients out of the ICU for procedures, mitigate against the likelihood of such a study being done.

**Table 1. Summary of studies to date reporting stroke in patients with COVID-19**

Reference	Study Population	Neurological Manifestation(s)	Diagnostic Studies
Mao L et al. Wuhan	Single-center, retrospective. 214 patients admitted to ICU with pneumonia	78 (36%) patients had neurologic findings (broadly defined). 6 had stroke (5 ischemic, 1 hemorrhagic). Other findings included: dizziness (16), headache (28), impaired consciousness (16), ataxia (1), seizure (1), impaired vision (3), taste (12), smell (11).	CT
Li Y et al. Wuhan	Single-center, retrospective. 221 hospitalized patients	12 (5.7%) patients had stroke (11 ischemic, 1 hemorrhagic). 2 stroke patients said to have no other COVID-19 symptoms.	CT
Oxley T et al. New York	Single-center, case series (denominator unknown) n = 5	5 young adults (median age 39) had large vessel ischemic stroke; 2 of these patients said to have no other COVID-19 symptoms.	CT, CTA, CTP, MRI
Klok F et al Netherlands	Multi-center, observational. 184 patients admitted to ICU with pneumonia	3 patients had stroke (all ischemic).	CT
Benussi A et al Milan	Single-center, 56 patients admitted to NeuroICU with COVID-19	35 patients had ischemic stroke and 3 had hemorrhagic stroke.	CT, MRI
Lodigiani C et al Milan	Single-center, retrospective 362 patients	28 patients with thromboembolic complication, 9 with stroke.	Not described
Helms J et al Strasbourg	Single-center, observational 58 hospitalized patients	49 (84%) patients had neurological symptoms. Two of these patients said to have no other COVID-19 symptoms	13 had MRI; 3 with ischemic stroke. 11 had perfusion MRI; all had perfusion abnormalities

## Imaging (MRI Brain)

MRI Brain shows new L MCA ischemic stroke in COVID-19 patient



## Conclusions

We hypothesize that: (1) stroke occurs in COVID-19 more frequently than is recognized; (2) a hypercoagulable state with inflammation at the site of local invasion of vascular endothelial cells by SARS-CoV-2, perhaps with a role for antiphospholipid antibodies, all contribute to the pathogenesis of stroke; and (3) more liberal use of anticoagulation in COVID-19 cases should be considered.

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