CASE REPORT

Appearance and rupture of a dissection aneurysm of the basilar trunk in a SARS-CoV-2 patient

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Abstract

The article describes a clinical case of a dissection aneurysm of the basilar artery in a SARS-COV-2 patient. The patient was treated in the hospital for infectious diseases due to bilateral poly-segmental pneumonia complicating a COVID-19 infection. A focal neurological deficit suddenly appeared and rapidly progressed, including paresis of the abducens nerve, bulbar disorders, and a right-sided hemiparesis. During the course of treatment, the patient underwent CT and CT angiography of the cerebral arteries several times. During the first examination, no pathology of the cerebral vessels was discovered. During the examination 10 days later, a fusiform aneurysm of the basilar artery trunk with a daughter sac was detected. Its rupture led to massive subarachnoid hemorrhage and an unfavorable outcome. The occurrence of primary symptoms in this patient could be due to a violation of the blood flow in the short branches of the basilar trunk in the area of the dissection.

Keywords: SARS-COV-2; COVID-19; stroke; subarachnoid hemorrhage; dissection aneurysm

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Introduction

The effects of the novel coronavirus 2019 (SARS-CoV-2) have not been fully elucidated. It is difficult and not always possible to reliably prove the relationship between an atypical course or outcome of a particular disease with SARS-CoV-2, especially in individual clinical cases or small series of observations. Nevertheless, it is very important to record such clinical cases, accumulate new data, and increase the awareness of colleagues about possible rare complications of SARS-CoV-2.

Clinical cases, series of observations, literature reviews, and several meta-analyses on cerebrovascular complications of SARS-CoV-2 were published in 2020-2021[1-6]. There was an increase in the frequency of stroke, decompensation of encephalopathy, and development of demyelinating diseases attributed to SARS-CoV-2 [2-4,7-9]. According to some reports, this is due to direct damage of the endothelium of cerebral vessels, glial cells and neurons, as well as the development of hypercoagulation and thrombocytopathy caused by the SARS-CoV-2 virus[3,4,9].

In SARS-COV-2 patients hospitalized in infectious diseases hospitals, hemorrhagic stroke develops in 0.2-1.5% of cases[2,3,7,10]. The frequency of subarachnoid hemorrhages (SAH) in patients with SARS-CoV-2 is not reliably known, and in the literature of the last two years, there are only isolated clinical cases and small series of observations[6,7,11,12]. Nawabi et al. (2020) analyzed 18 cases of non-traumatic intracranial hemorrhages (ICH) in SARS-CoV-2 patients, among whom six patients had ICH (33.3%), 11 had SAH (61.1%), and one patient had non–traumatic subdural hematoma (5.6%)[8]. This ratio of different locations of hemorrhages in patients with a new coronavirus infection is unusual, given that in non- SARS-CoV-2 patients, SAH is only seen in 10-15% of cases. Some researchers suggest that SARS-CoV-2 can cause the formation of dissection aneurysms, as well as lead to rupture of existing saccular intracerebral aneurysms[7,13].

This article presents a rare case of a SARS-CoV-2 patient with formation and rupture of a basilar artery dissection aneurysm within a few days of infection.

Case report

A 45-year-old male patient was admitted to the infection diseases hospital on December 18, 2021. He was treated for a SARS-CoV-2 infection complicated by bilateral poly-segmental pneumonia. Since admission, the patient had a severe headache (up to 8 points on a visual analog scale).

To exclude acute cerebral pathology, the patient was examined by a neurologist, who revealed convergent strabismus due to paresis of the left abducens nerve. Multi-slice computerized tomography (MSCT) and MSCT angiography of the brain were performed but it remained unremarkable (***Figure 1***).

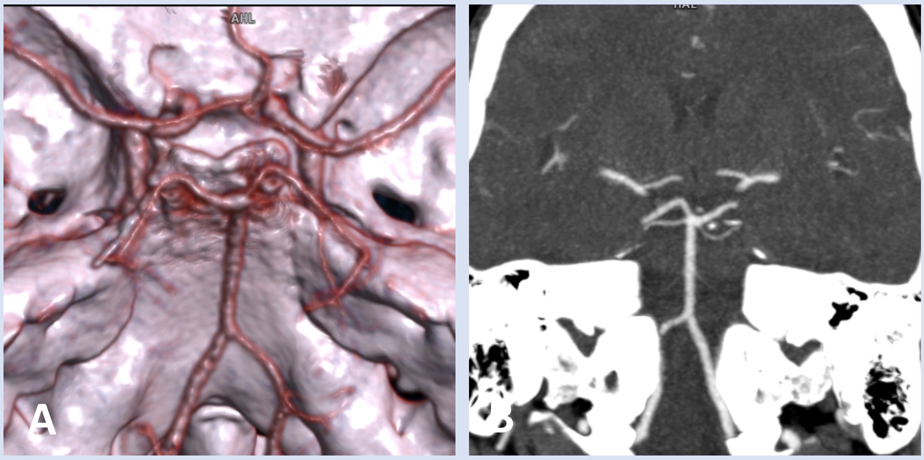

Figure 1. MSCT angiography: A. 3D reconstruction; B. CT angiography of the vertebrobasilar trunk. The basilar artery was unchanged.

January 2, 2022: The patient's headache worsened. There were no finding supporting a diagnosis of SAH. To exclude CNS infection, a lumbar puncture was performed. Cerebrospinal fluid (CSF) pressure was not increased, the color of CSF was transparent, with 4 cells in 1 µl and a protein level of 0.43 g/l.

On January 6th the patient had fever up to 30-38.5°C, leukocytosis up to 15*10^{9}, and C-reactive protein was 145. There was no consciousness disturbance (Glasgow Coma Scale (GCS) 15), he was emotionally labile, with a paresis of the left abducens nerve, and no meningeal signs. CSF from lumbar puncture contained 680 cells in 1 µl and 0.56 g/l proteins. Meningoencephalitis was diagnosed and antibiotics were prescribed.

Next morning, the patient complained of slurred speech and weakness in his right arm and leg. Neurological examination noted GCS 12, palpebral fissures asymmetry D<S, dysarthria, paresis of the left abducens nerve, and a moderate right-sided hemiparesis. Since a stroke was suspected, MSCT was repeated but detected no structural pathology of the brain, to diagnose an acute meningoencephalitis with oculomotor disorders (paresis of the left VI CN). A differential diagnosis of vertebrobasilar stroke was considered.

In the evening, worsening of hemiparesis to hemiplegia, reduced pharyngeal reflex, and dysphagia were noted. Repeated MSCT and MSCT-angiography revealed a fusiform aneurysm of the basilar artery with a daughter sac directed to the left, without structural brain pathology (***Figure 2***).

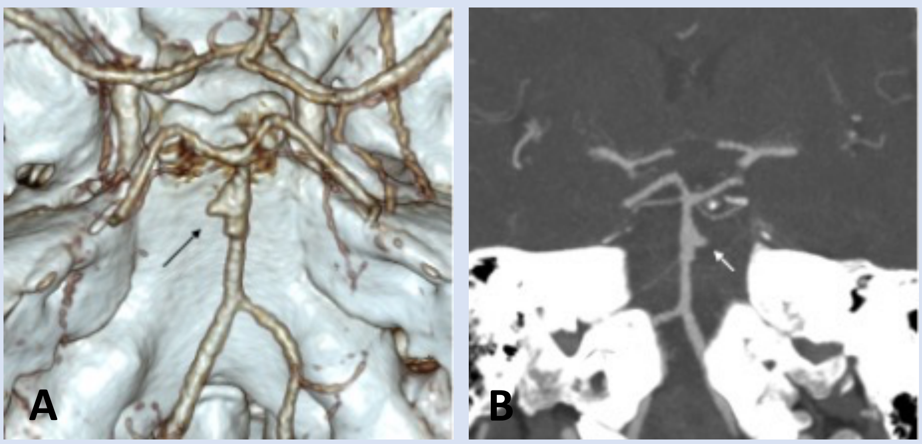

Figure 1. MSCT angiography, 10 days after the initial. A. 3D reconstruction; B. fusiform aneurysm of the basilar artery with a daughter sac directed to the left.

The patient was seen by a neurosurgeon. Cerebral digital subtraction angiography (DSA) was planned to clarify the possibility of endovascular treatment of the aneurysm.

On the morning of January 8, 2022, the patient's condition worsened, with deterioration of consciousness to coma (GCS 6). The patient was moved to the intensive care unit, intubated, and artificial ventilation of the lungs was started. A CT scan of the brain was performed immediately. A massive SAH (Fisher III) was detected (***Figures 3A and 3B***) and MSCT angiography showed an increase in size of the fusiform aneurysm of the basilar artery (***Figures 3C and 3D***).

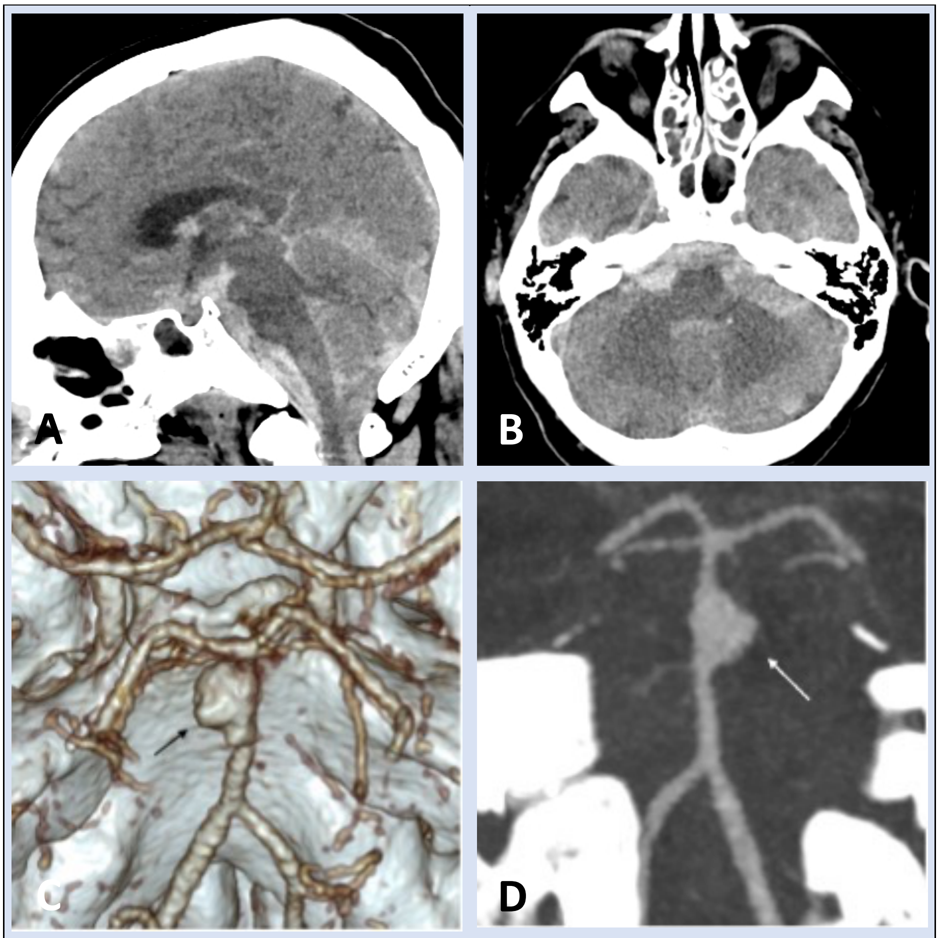

Figure 1. MSCT revealed massive SAH in the basal cisterns: A. sagital plane; B. axial plane; with MSCT angiography: C. 3D reconstruction; B. an increase in size of the fusiform aneurysm of the basilar artery was seen.

Repeated examination by a neurosurgeon, taking into account the severity of the condition (Hunt-Hess V), found no indication for surgical treatment.

January 9, 2022: The patient's condition was terminal, demonstrating coma III, muscular atony, and areflexia. Cardiac arrest was recorded despite increasing doses of cardiotonic drugs. Resuscitation was conducted for 30 minutes without effect followed by a lethal outcome.

Discussion

Analyzing this clinical case, it is possible to suggest the following sequence of pathogenetic events: the COVID-19 virus, tropic to the endothelium, caused damage to the cerebral vessels, with greater involvement of the basilar artery and inflammation of its wall, which led to the destruction of the endothelium and the internal elastic membrane, triggering dissection. Against the background of progressive dissection of the wall of basilar artery, there was a consistent violation of blood supply in the perforating arteries that supply the brainstem, accompanied by the appearance and increase of focal neurological symptoms (paresis of the abducens nerve, bulbar disorders, hemiparesis). Further progression of the dissection led to the formation of a dissection aneurysm with a very thin wall, the rupture of which led to massive SAH and subsequent death of the patient.

According to the classification of Yonekura (2002), the formation and growth of aneurysms can occur in four types: type 1 - aneurysm ruptures within a short period of time after formation (days-weeks), type 2 – aneurysm grows slowly (several years) and ruptures when it reaches a certain size, type 3 – aneurysm grows slowly (several years) without rupture. type 4 – the aneurysm grows to a certain size and then remains stable[14]. In this clinical case, a type 1 aneurysm formation was seen. At the same time, when the formation of an aneurysm occurs within a few days or weeks, its pathogenesis is most often associated with inflammation and dilation of the cerebral vessel wall, or with dissection of the wall. Such aneurysms are known as "infectious aneurysms" and "dissection aneurysms". Infectious aneurysms occur in 2-4% of all cerebral aneurysms[15,16], and dissection aneurysms occur in approximately 1% of cases[17].

Infectious aneurysms can form within a few days to several months and have a high risk of rupture[18]. According to John et al. (2016) the risk of aneurysm formation occurs 24 hours after the development of inflammation in the artery wall[19].

The pathogenesis of infectious aneurysms is quite well studied. An inflammation of the cerebral artery wall impairs its ability to resist arterial pressure, leading to over-stretching and aneurysm formation. In most cases, such aneurysms do not have a neck and are fusiform and located in the distal, often cortical branches, of the cerebral arteries. There is little evidence that the formation of infectious aneurysms is also possible in the initial segments of the circle of Willis[15]. In 70-80% of cases, the formation of infectious aneurysms is caused by a bacterial lesion of the artery wall[15,16]. However, there is evidence that they may be based on a viral lesion of the vessel[13].

Keller et al. (2020) performed magnetic resonance imaging (MRI) with a paramagnet in patients with cerebrovascular complications of SARS-CoV-2. In some cases, an accumulation in the walls of large cerebral arteries was detected, indicating an inflammation[20].

According to Castillo et al. (2020) the SARS-CoV-2 virus affects ACE2 receptors that are expressed in the endothelium and muscle cells of intracranial vessels, leading to wall damage and triggering the process of its dissection[10]. A number of researchers suggest such a pathogenesis of vascular dissection against the background of a new coronavirus infection[1,7,13].

In 2020-2021, multiple series of SARS-CoV-2- patients with dissections of extra and intracranial arteries were published[21-23]. Most often dissections of the vessels of the neck and intracranial vessels lead to ischemic disorders of cerebral circulation, but hemorrhagic complications were also reported.

According to Chen et al. (2005), vessel wall dissection between the intima and the muscular layer is most often accompanied by the development of ischemic complications, whereas a dissection between the muscular layer and adventitia is accompanied by the development of aneurysms and hemorrhagic complications[24].

Al-Mufti et al. (2021) studied cerebrovascular complications in patients with SARS-CoV-2, and described three cases of dissection of extra- and intracranial vessels, while in one patient, a dissection of the middle cerebral artery led to massive subarachnoid hemorrhage[1].

There is a pathogenetic relationship between inflammation of the cerebral artery wall, the development of its dissection, and the formation of an aneurysm. Zhong and colleagues (2017) presented a clinical case of a 17-year-old patient who was treated for acute infectious endocarditis. On the tenth day of treatment, the patient developed left-sided ptosis. Additional examinations were performed (MRI and CT angiography, DSA), and a dissection aneurysm of the cavernous part of the internal carotid artery was detected. The patient underwent endovascular embolization of the aneurysm with micro-coils and stent assistance. The operation was uneventful, the ptosis regressed, and the patient was discharged in a good clinical condition[25].

Only isolated cases of cerebral dissection aneurysms in SARS-CoV-2- patients have been described[6,7,13,26].

Savić et al. (2020) published a case of formation and rupture of an aneurysm of the middle cerebral artery in a 13-year-old girl with SARS-CoV-2. The authors believe that the dissection of the wall and the formation of an aneurysm of the M2 segment of the left middle cerebral artery was associated with a viral lesion of the artery. However, they could not completely exclude the possibility of an aneurysm before the disease, which could only provoke its rupture[13].

Al Saiegh et al. (2020) described a case of ruptured dissection aneurysm of the posterior inferior cerebellar artery in a 31-year-old patient with SARS-CoV-2. The patient had a flow-diverter stent placed and the aneurysm was excluded from the blood circulation[26].

In a series of 22 cases of SARS-CoV-2-related cerebrovascular complications, Sweid et al. (2020) noted three cases of ruptured intracerebral aneurysms. According to the description and presented images, two aneurysms were typical saccular ones, located in the region of branching (in the origin of the posterior communicating artery and in the origin of the anterior choroidal artery), and the aneurysm of the posterior inferior cerebellar artery was dissection type[6].

Dodd et al. (2021) analyzed ruptured cerebral aneurysms in 10 patients with SARS-CoV-2. In 4 cases, aneurysms were dissection type – and three were in the vertebrobasilar territory – which is much more common than among patients with ruptured cerebral aneurysms without coronavirus infection (about 1%). In addition, it was noted that these were younger patients (mean age 38.5 years) than in the general population of patients with SAH (most often in range of 50-60 years)[7].

In all of these studies, there were patients with both severe, mild and even asymptomatic SARS-CoV-2 infections.

Based on all currently available literature, we present the first CT angiography documented case of acute formation of the dissection aneurysm in a patient with SARS-CoV-2.

Conclusion

SARS-CoV-2 appears to have had an impact both on the increase in the frequency of cerebrovascular disorders and on the severity and atypical nature of their clinical course.

A rare, but important, complication of SARS-CoV-2 is a viral lesion of the cerebral artery wall causing its destruction and the formation of a dissection aneurysm with a very thin wall and a high risk of rupture.

In patients with SARS-CoV-2 and non-traumatic SAH and ICH, it is necessary to carefully examine the condition of cerebral vessels for dissections and dissection aneurysms. In unclear cases, as well as with small aneurysms, cerebral angiography has maximum informative value.

In patients with SARS-CoV-2, the first line of treatment for dissection aneurysms (with or without rupture) may be endovascular exclusion (embolization with stent assistance, placement of flow diverter stents). When endovascular exclusion of a dissection aneurysm is not possible, it may be necessary to consider possible options for microsurgical treatment.

Disclosures

Conflict of Interest: All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (Krasnoyarsk State Medical University named after Prof. V.F. Voino-Yasenetsky and FSBI “Federal Center of Neurosurgery”, Novosibirsk) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

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