



An enigmatic case of central nervous system infection and superior sagittal sinus thrombosis in an adolescent with COVID-19

Michał Bielak^{1,A-D}, Natalia Biel^{1,C-D}, Karolina Urbańska^{1,C-D},
Magdalena Chrościńska-Krawczyk^{2,A-B,E-F}

¹ Students' Scientific Association, Department of Paediatric Neurology, Medical University, Lublin, Poland

² Department of Children's Neurology, University Children's Hospital, Lublin, Poland

A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical revision of the article, F – Final approval of the article

Bielak M, Biel N, Urbańska K, Chrościńska-Krawczyk M. An enigmatic case of central nervous system infection and superior sagittal sinus thrombosis in an adolescent with COVID-19. *J Pre-Clin Clin Res.* 2022; 16(3): 79–80. doi: 10.26444/jpccr/153542

Abstract

COVID-19 neurological manifestations vary from mild symptoms, such as fatigue, to severe complications. This article presents a case of a 15-year-old male with multiple brain abscesses, meningitis, massive sinusitis and sagittal sinus thrombosis. SARS-CoV-2 IgM and IgG antibodies were increased, while blood and CSF cultures, anti-HSV antibodies and IGRA were negative. The patient responded well to the initial treatment with broad-spectrum antibiotics, glucocorticoids and intravenous immunoglobulins. After two weeks, his clinical state suddenly collapsed, with the progression of purulent lesions in the MRI. Urgent craniotomy was performed. A follow-up MRI confirmed regression of the purulent lesions. Negative blood and CSF cultures, as well as insufficiency of the broad-spectrum antibiotic therapy, suggested an atypical or opportunistic CNS infection, characteristic of immunocompromised patients. This strengthens the hypothesis that SARS-CoV-2 infection may lead to decreased immunocompetence.

Key words

COVID-19, brain abscess, subdural empyema, superior sagittal sinus thrombosis

CASE REPORT

The COVID-19 pandemic is an enormous challenge for global health. COVID-19 infection is characterized by a variety of symptoms involving almost every organ system. Although a great number of paediatric patients can be asymptomatic, some of them develop severe, life-threatening complications. In symptomatic children, the most common symptoms of COVID-19 infection are fever and cough. Less common are dyspnea, rhinorrhea, and gastrointestinal symptoms [1]. Neurological manifestations of COVID-19 vary from mild symptoms, such as headache, fatigue, anosmia and ageusia, to severe ones, including encephalopathy, seizures, meningitis/encephalitis and stroke [2].

A 15-year-old male was admitted to the Intensive Care Unit, presenting high fever, altered consciousness, severe nuchal rigidity and positive Kernig's sign. Head CT revealed massive sinusitis and several irregular hypodense areas in the basal part of the left frontal lobe. Brain MRI confirmed the presence of multiple brain abscesses, as well as meningitis, bilateral subdural empyemas (causing a slight mass effect), and sagittal sinus thrombosis. The patient was tested for COVID-19; the rapid antigen test was negative, whereas SARS-CoV-2-specific antibodies were increased (with the prevalence of IgG over IgM antibodies). CSF and blood cultures were negative for aerobic and anaerobic bacteria. Furthermore, *Neisseria meningitidis* latex test, *Streptococcus*

pneumoniae and *Staphylococcus pyogenes* antigen tests, anti-HSV antibodies and interferon-gamma release assay, were also negative.

The patient was treated with broad-spectrum antibiotics, glucocorticoids and intravenous immunoglobulins; FFP and intravenous antithrombin III were applied to rebalance coagulation abnormalities. He responded well to the initial treatment and, after a week, was referred to the Paediatric Neurology Clinic in a stable condition; however, there was still no verbal contact with the patient. Two weeks later, symptoms of growing intracranial pressure suddenly appeared. Head MRI revealed progression of the purulent pericerebral lesions, with a subdural empyema in the left frontoparietal region causing a significant mass effect. Sagittal sinus thrombosis receded. Urgent craniotomy was performed to avoid the risk of cerebral herniation. Intraoperative cerebrospinal fluid sample was taken for culture, which once again came back negative. After neurosurgery, the patient's condition improved considerably. A follow-up MRI performed one month after the surgery confirmed regression of the purulent lesions.

In this case, two different severe neurological complications – superior sagittal sinus thrombosis and purulent infection of the central nervous system – occurred simultaneously after SARS-CoV-2 infection. Negative blood and CSF cultures, as well as insufficiency of the broad-spectrum antibiotic therapy suggest an atypical or opportunistic CNS infection, characteristic of immunocompromised patients.

Interestingly, on reviewing the literature, a case report was found of a patient with an identical triad of invasive sinusitis, brain abscess and COVID-19. A 49-year-old man with a history of uncontrolled diabetes and mild symptoms of

Address for correspondence: Michał Bielak, Students' Scientific Association, Department of Paediatric Neurology, Medical University of Lublin, Gełbali 6, 20-093 Lublin, Poland
E-mail: michal.jakub.bielak@gmail.com

Received: 30.06.2022; accepted: 05.09.2022; first published: 15.09.2022



Figure 1. T2 MRI performed after the admission to the Intensive Care Unit. Paracerebral empyemas anteriorly to the left frontal lobe and abscesses (the largest 11 mm wide) at the base of the frontal lobe. Total opacification of the left maxillary sinus

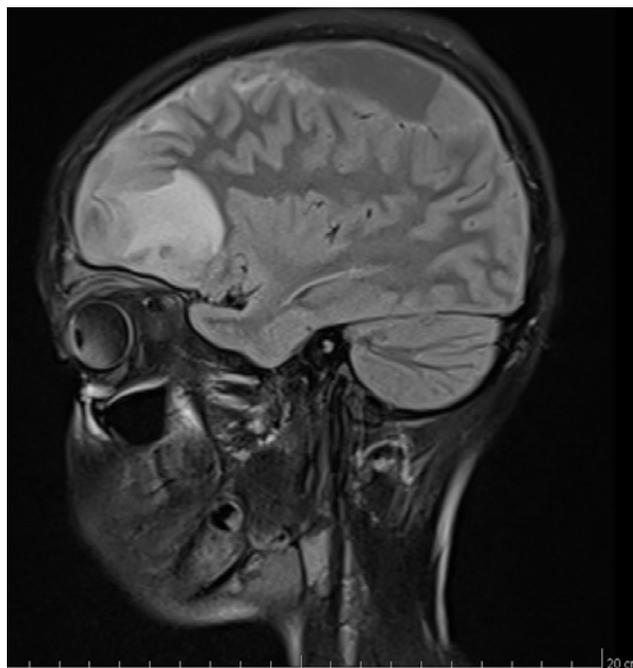


Figure 3. T2 MRI performed two weeks after the admission to the Paediatric Neurology Clinic. Abscesses and parenchymal edema visible in the left frontal lobe and subdural empyema pressing on the left hemisphere

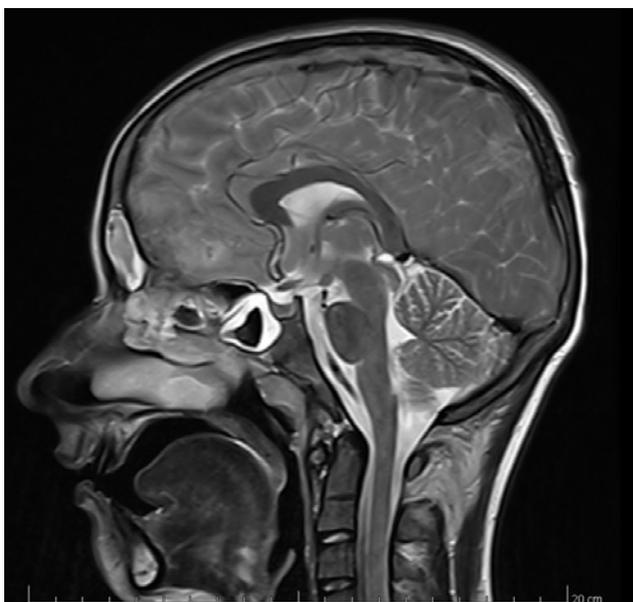


Figure 2. T2 MRI performed after the admission to the Intensive Care Unit. Superior sagittal sinus thrombosis and thickening of the sphenoid sinus walls

COVID-19 was admitted to the ICU, presenting generalized tonic clonic seizures. Similarly to the presented case, a broad differential diagnosis was performed, but no specific pathogen was identified. The patient was treated with broad-spectrum antibiotic therapy; after two weeks, however, progression of purulent lesions was observed. This case also suggests an opportunistic infection following COVID-19 in a man who was previously immunocompetent [3].

SARS-CoV-2 infection causes hypercoagulability and inflammation leading to venous thrombotic events and subsequent neurological complications, such as stroke or cerebral venous thrombosis. This usually affects elderly

patients with comorbidities and a severe course of COVID-19. However, a higher incidence of such complications in younger groups has been observed, including children with no underlying conditions and a mild or asymptomatic course of SARS-CoV-2 infection [4].

SARS-CoV-2, like other coronaviruses, might suppress the early type-1 IFN response, leading to hyperinflammation. While the infection progresses, it leads to the impairment of the immune system. Immune cell apoptosis, lymphopenia and lymphocyte dysfunction result in immunosuppression [5]. This strengthens the hypothesis that SARS-CoV-2 infection may lead to impaired immunity and, consequently, to severe secondary infections of different organ systems, including CNS. More research needs to be done to fully understand the risk and prevalence of atypical secondary infections in children and adolescents with COVID-19.

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