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CASE REPORT

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A fulminant presentation of post-COVID-19 necrotizing pneumonia and ischemic stroke in an 8-year-old girl: A case report and literature review

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Key Clinical Message

Necrotizing pneumonia (NP) is the destruction of the interstitial part of the lung due to severe infection. One cause of this rare and fatal condition in pediatrics is Acinetobacter. Severe infections, especially pneumonia, can prone pediatric patients to ischemic stroke. This study reports an 8-year-old girl presented to the emergency department complaining of shortness of breath, fever, and fatigue. She was admitted to the intensive care unit due to respiratory distress and pericardial effusion. Swab and respiratory secretion tests for COVID-19 and Acinetobacter were positive. In her admission course, her condition deteriorated, and on the fifth day, she underwent a craniotomy due to the signs of increased intracranial pressure (ICP). The computed tomography (CT) scan showed an ischemic stroke. Despite all efforts and medical efforts, the patient's clinical condition got worse, and she died 10 days after the surgery. COVID-19 can lead to vulnerability to severe bacterial infections such as NP in pediatrics. Severe infections are a significant risk factor for ischemic stroke. The presentation might be different in intubated unconscious patients, such as detecting increased ICP signs. In severe and extensive cases of NP and ischemia, the destruction of the lungs and brain tissue might be irreversible and even lethal. Doctors and parents should consider neurologic complaints in children with infectious diseases as a serious issue since infections make children vulnerable to complications such as stroke.

KEYWORDS

Acinetobacter, COVID-19, ischemic stroke, pediatrics, pneumonia

1 | INTRODUCTION

Necrotizing pneumonia (NP) is a catastrophic infection of the lungs, characterized by the necrosis of the interstitial tissue, causing prolonged hospital stays and a relatively high mortality rate.[1] This condition destroys the backbone of the lungs and leaves them with thin-walled and malfunctioning small cavities in this organ.[2,3] Although rarely reported, NP can be seen as a complication of COVID-19 pneumonia.[4] Acinetobacter pneumonia has

been mentioned in studies as a rarely-detected cause of NP in children, and this microorganism is mostly seen in patients younger than 5 years old and commonly correlates with thrombocytopenia, peripheral blood smear with polymorphism, CRP ≥12, and without the comorbid disease.[5] The respiratory tract is the most common site of Acinetobacter colonization and infection.[6] Infections, specifically respiratory system-involved ones, can cause vulnerability to other pathologies, such as cerebrovascular accidents (CVAs).[7]

Acute ischemic stroke (AIS) is a rare occurrence in children (30 days −18 years old). It is highly associated with infectious diseases in 24% of AIS cases.[7,8] The most commonly associated microorganisms with pediatric AIS are varicella zoster virus (VZV), mycoplasma pneumonia, chlamydia pneumonia, human immunodeficiency virus (HIV), mumps virus, *Borrelia burgdorferi*, parvovirus B19, and influenza A virus.[9] Although not commonly reported, pneumonia has been demonstrated to be a potential risk factor for infectious-related cases of AIS in children.[10] The COVID-19 pandemic is one of the most serious health concerns of humankind's history, and it is associated with a wide range of complications in children, especially CVAs.[11,12] Previous reports of the coincidence of COVID-19 and stroke in children have been reported, and it has been shown that the diagnosis might be delayed and cause more serious complications.[13,14] The mechanism of the trigger of stroke in these patients seems to be related to both virus-induced vasculopathy and the activation of pathologic thromboembolic mechanisms.[14]

In the present study, we report an 8-year-old girl with the diagnosis of AIS occurring after COVID-19 pneumonia and Acinetobacter superinfection. According to the authors' best knowledge, this is the first case of CVA, and concomitant post-COVID-19 NP ever reported.

2 | CASE PRESENTATION

2.1 | Case history and examination

The patient was an 8-year-old girl who presented with shortness of breath, fatigue, fever, left-side dull chest pain, and severe productive coughs to the emergency department (ED) of a pediatric hospital. She had no remarkable past medical history except seasonal allergies until 10 days before her presentation when she was diagnosed with COVID-19 pneumonia. Her condition had been improving after symptomatic and conservative treatment with ibuprofen syrup and suppository acetaminophen three times a day (TDS) for her fever and diphenhydramine syrup for her cough. However, her cough, shortness of breath, and fever had deteriorated in the last 2 days before her presentation to the ED. Her severe cough had caused her inability to sleep and intermittent vomiting. In her initial physical examination in the ED, she was conscious but ill in general appearance. Moreover, she had a high body temperature (40°C), increased heart rate (130/min), elevated respiratory rate (33/min), inclined blood pressure (134/86 mmHg), and low blood oxygen saturation (75% and 82%, before and after receiving oxygen, respectively). The patient was breathing hard, using abdominal muscles. Bilateral crackles and a decreased breathing sound in the lower left chest were detected in her chest auscultation.

2.2 | Methods

Treatment with a non-rebreathing oxygen mask and an intravenous (IV) infusion of fluids started immediately. Her chest X-ray (CXR) revealed a left-side white lung, bilateral pleural effusion (PE), consolidation and collapse of the left lung's lower lobe, and parenchymal involvement of both lungs (Figure 1). Her chest computed tomography scans (CT scans) also confirmed the presence of bilateral pneumonia and PE, as well as left-side consolidation (Figure 2). Based on the recommendation of a pediatric infectious disease specialist, she was transferred to Rasoul Akram Complex Hospital with an ambulance and medical team observation, admitted to the pediatric intensive care unit (PICU), and given an IV infusion of meropenem, vancomycin, oseltamivir, and remdesivir. Meropenem and vancomycin were chosen based on the most common microorganisms found in concomitant bacterial infections occurring during COVID-19 infection and the less resistance to them compared to other antibiotics covering

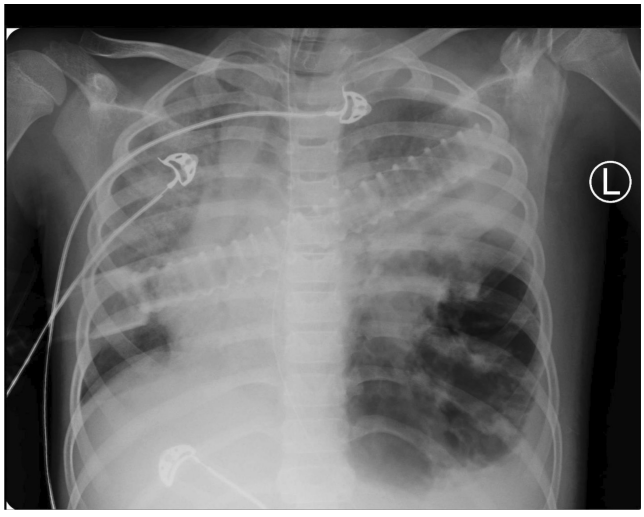

FIGURE 1 Bilateral parenchymal lung involvement, bilateral pleural effusion, left lung lower lobe consolidation, and collapse were observed in the patient's initial chest X-ray.

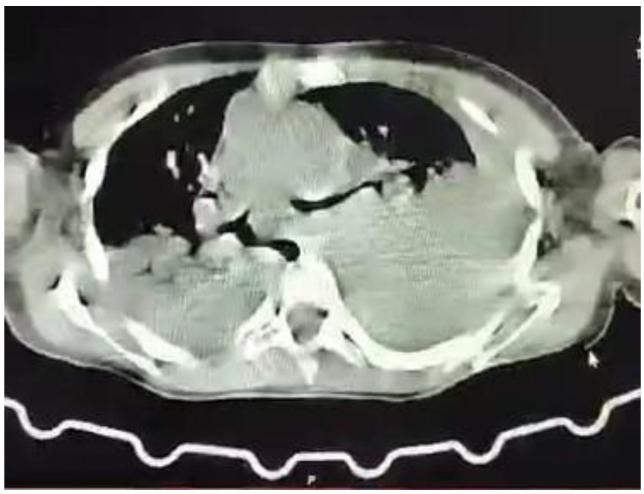

FIGURE 2 Bilateral pleural effusion and left lower lobe consolidation and collapse were obvious in the index chest CT scan of the patient.

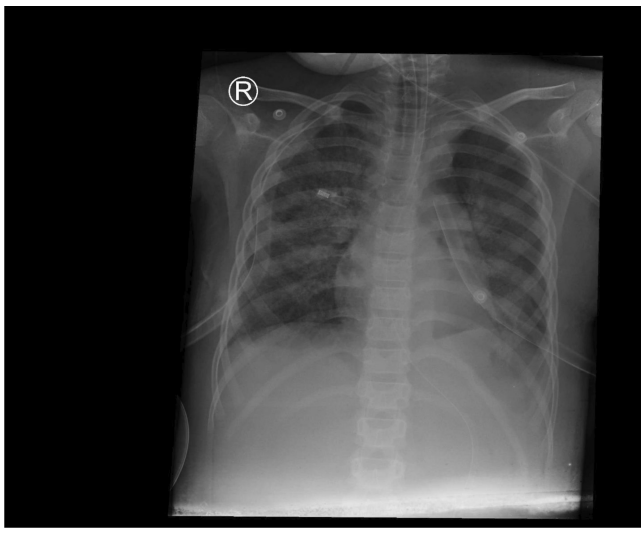

FIGURE 3 Chest X-ray of the patient after thoracotomy and left lower lung lobectomy due to fulminant necrotizing Acinetobacter pneumonia.

various types of microorganisms. Due to the lack of improvement in her respiratory status after 30 min, PICU specialists decided to use bilevel-positive airway pressure (BIPAP) to assist her respiration. The patient's clinical condition continued to worsen. Therefore, she was intubated after receiving IV midazolam and propofol for sedation. After 12 h, the patient's fever was resolved, but her blood pressure dropped to 85/45 mmHg. Her antibiotics were changed to IV meropenem and colistin, and intravenous immunoglobulin (IVIG) therapy was initiated due to the suspicion of COVID-19 pneumonia. A polymerase chain reaction (PCR) test from nasal and oral cavities for influenza and COVID-19 viruses, bacterial culture from sputum, and pleural ultrasonography to determine the severity of the PE were requested. Following the detection of massive PE in her left and moderate PE in her right chest, the bilateral chest tube was inserted, and considering continuous high-volume drainage of the left chest and deterioration of the respiratory condition, she was transferred to the operation room (OR) for a left thoracotomy. In the OR, the thoracic surgeon found left lung lower lobe necrosis, then decided to perform the lobectomy and repeated the CXR to evaluate the progression of her condition (Figure 3). She was under observation in the PICU for 5 days after the surgery and the addition of an antifungal IV medication (amphotericin) to her previous medical order. The addition of the antifungal was based upon the fact that they are one of the probable causes of NP and severe PE caused by this type of infection. In the routine visit on the fifth day, anisocoria was detected. While her left pupil had a normal size, the right one was fixed, dilated, and 5 mm in diameter. Urgent consultation with pediatric neurosurgery was requested, and the neurosurgeon decided to perform a craniotomy in the OR immediately due to a diagnosis of high intracranial pressure (ICP) and probable hemorrhagic CVA. Following transmission to the OR and craniotomy, the patient's brain was bulged out of the skull due to intracranial hemorrhage. The brain CT scan after the surgery revealed hypodensity and subsequent transformation to hemorrhagic CVA in the right middle and posterior cerebral arteries (MCA and PCA), along with midline shifts (Figures 4 and 5). Performing magnetic resonance imaging (MRI), magnetic resonance angiography (MRA), and magnetic resonance venography (MRV) for more detailed information is postponed due to the instability of the patient's clinical condition.

2.3 | Conclusion and result

After being returned to the PICU, hypertonic fluid IV infusion, IV enoxaparin, and consultation with a pediatric immunologist were added to her treatment plan to decline her elevated ICP, prevent repetition of CVA, and find probable immunodeficiency, respectively. The day after the surgery, the patient experienced several episodes of tonic–clonic seizures, which persuaded her physician to add IV phenytoin to her medications. The results of her PCR revealed COVID-19 pneumonia and the sputum culture showed Acinetobacter infection with sensitivity to meropenem and colistin. Despite continuing medical treatment and respiratory support with a mechanical ventilator with the diagnosis of post-COVID-19, Acinetobacter superinfection NP, and CVA, the patient's condition did not improve. Her blood pressure remained low (80/40 mmHg), her Glasgow Coma Scale did not increase from the minimum (3/15), and her oxygen saturation was 83%.

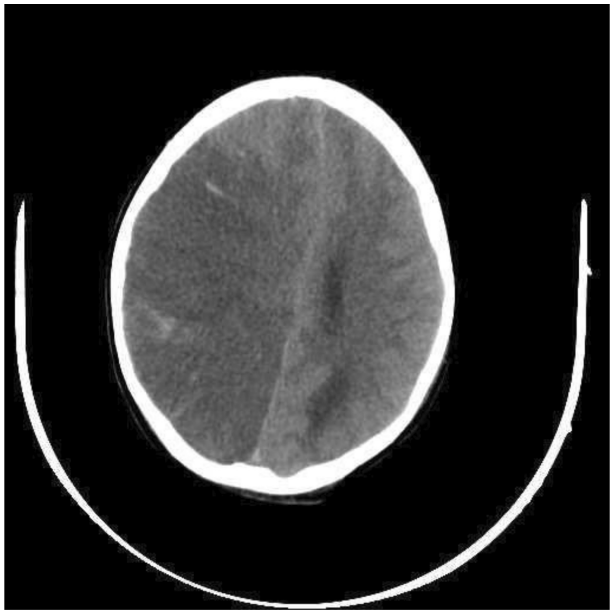

FIGURE 4 A brain CT scan on the fifth day of admission showed AIS and hemorrhagic transformation in the right MCA and PCA territory after post-COVID-19 Acinetobacter necrotizing superinfection pneumonia.

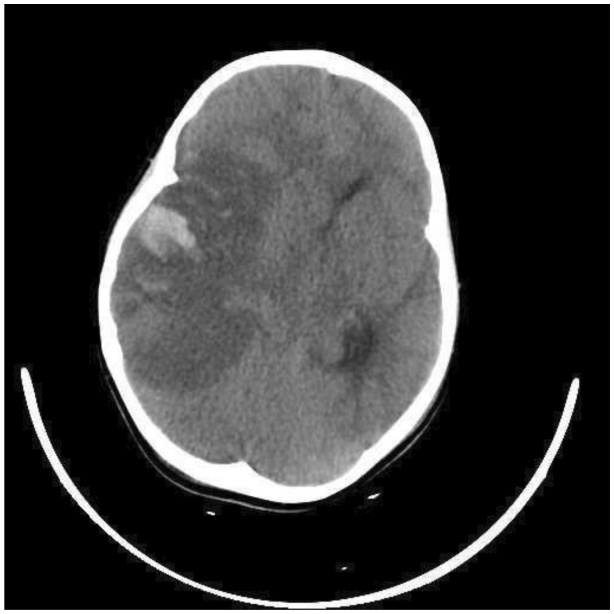

FIGURE 5 A brain CT scan of the patient on the fifth day of admission revealed necrotizing ischemic CVA and hemorrhagic transformation in the right MCA and PCA territory after post-COVID-19.

Therefore, an IV infusion of epinephrine and maximum respiratory support were performed. The patient's treatment was under observation in the PICU for 10 days after the craniotomy surgery. The immunologic evaluation for a possible diagnosis of immunodeficiency disorder was inconclusive. Despite all efforts to save the patient, she had a cardiac arrest. Her cardiorespiratory resuscitation for 45 min was fruitless by the PICU team, and the patient expired on the 15th day of hospitalization due to the fulminant post-COVID-19 Acinetobacter NP and CVA. Considering the progression of the patient's disease and the catastrophic severity of symptoms before presentation to the ED, the possibility of child neglect was considered. Therefore, a consultation with the forensic medicine service was requested to investigate the evidence and rule out this probability. Figure 6 provides a timeline of the events.

3 | DISCUSSION

COVID-19 could have various manifestations in children, ranging from an asymptomatic incidental diagnosis up to hypoxemic respiratory failure, which might lead to acute respiratory distress syndrome (ARDS).[15] One of the most crucial determinants of the symptom's severity is bacterial coinfection or superinfection, along with COVID-19 pneumonia.[16] Mycoplasma pneumonia, pseudomonas aeruginosa, and Hemophilus influenza are the most common causes of concomitant bacterial pneumonia with COVID-19 that can be present in up to 14% of ICU-admitted patients with this diagnosis.[17] NP, characterized by the destruction of the pulmonary parenchyma and the presence of thin-wall malfunction chambers in the lungs, has been rarely reported as a complication of COVID-19.[4] In the patient presented in our study, Acinetobacter seems to be the reason for NP after the COVID-19 infection and the patient's critical condition.

NP can have different extensions, ranging from a limited patchy or lobar infection to extensive involvement of the entire lung.[18] Although pneumococcal conjugate vaccination has led to a declining rate of hospitalized pneumonia in pediatrics,[19] an increasing trend has been reported in the incidence of NP among children.[1] A study in France revealed an increasing incidence of NP, from 4.5% of community-acquired pneumonia (CAP) cases in 2006 to 9% in 2011.[20] This fatal fulminant infection is mostly diagnosed with radiologic modalities. Although background parenchymal involvement can be seen in CXR, the low sensitivity of this modality for detecting accompanied PE and cavitations caused by liquefactive necrosis has made it an imperfect choice.[20] A chest CT scan is the more sensitive and currently the optimal radiologic mode for diagnosing NP.[21] The main treatment for this condition is prolonged inpatient IV antibiotic therapy after finding an effective choice with the culture of respiratory secretions, accompanied by a probable need for surgical intervention or oral medications.[22]

One of the rarely reported causes of NP is Acinetobacter bacteria. Acinetobacter species are mostly seen in people who have been in healthcare facilities as workers or patients, injured people in militaries, colonized the skin

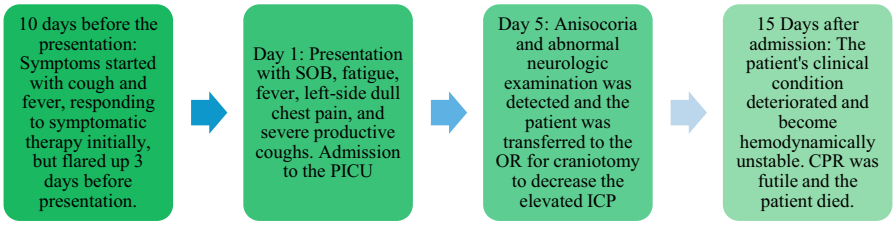

FIGURE 6 The timeline of disease progression. CPR, cardiopulmonary resuscitation; ICP, intracranial pressure; OR, operation room; PICU, pediatric intensive care unit; SOB, shortness of breath.

and respiratory tracts of healthy individuals,[23] and were responsible for 6% of ventilator-associated pneumonia between 1992 and 1997 in the United States of America.[24] Other commonly identified risk factors for Acinetobacter pneumonia are a history of head trauma, neurosurgical procedures, intubation and mechanical ventilation, ICU admission, various antibiotic infusions, and large-volume aspiration into the lungs.[25–27] However, patients with specific features, such as immune-system malfunction, would also be more susceptible to community-acquired Acinetobacter pneumonia, including *Acinetobacter baumannii*.[28] This was the organism detected in our patient's sputum culture. Casarotta et al., in a recent retrospective observational study, concluded that a combinational therapy with nebulized and IV colistin, high-dose tigecycline, and ampicillin/sulbactam is an effective combination for the treatment of this type of pneumonia.[29] In the presented case, the patient was treated with broad-spectrum antibiotics (meropenem and vancomycin) before obtaining a sample of his respiratory secretions and their culture. Moreover, remdesivir and oseltamivir were added to the therapeutic regime, considering the high probability of ARDS due to COVID-19 infections. However, after observing undesirable clinical conditions and severe infection, colistin infusion was initiated as one of the most potent antibiotics against multidrug-resistant Gram-negative organisms. The sputum culture result was also approved for the suitability of the chosen antibiotics.

Stroke is an extremely rare incident in pediatrics, with age ranges between 30 days and 18 years old, with varying incident rates based on the sociodemographic features of the population.[30] The incident rate is estimated to be 2.5–13/100,000 patients annually.[31,32] AIS is more commonly seen than hemorrhagic types in pediatrics, and based on the territory of involvement, it can cause different presentations.[7] Seizures (the most common), focal deficits such as hemiparesis, and non-specific symptoms such as respiratory diseases, fever, headache, and vomiting are common presentations of AIS in pediatrics.[30] Since our patient was unconscious and intubated, a limited probable presentation of AIS could be detected. However, seizures were the most commonly seen manifestation, and anisocoria was observed in this patient. Observing unequal fixed pupil sizes resulted in the diagnosis of AIS by the brain CT scan performed after her urgent craniotomy. Several risk factors for AIS in pediatrics include congenital heart disease, sickle cell disease, infections, and collagen disorders.[33] Notably, there is a direct causal correlation between infection and AIS in children, mostly attributed to the consequent focal arteriopathies, vasculitis, and in situ venous thrombosis.[34] Even though COVID-19 infection is detected as a known risk factor for the incidence of AIS in adults, this infection's association with pediatric AIS has remained unclear.[11] However, a history of COVID-19 pneumonia is revealed to be a risk factor for AIS, and acute pneumonia with this virus, like other viral infections, was shown to be a trigger for AIS.[11] Eight cases of post-COVID-19 CVAs in pediatrics are also provided in the literature review in Table 1.

Several hypotheses have been proposed as the probable mechanism of induction of COVID-19-related AIS. The vasculopathy and the inflammation caused by the viral infection were shown to be an associated link between these two pathologies. Moreover, COVID-19 infection has been shown to be an activating factor for coagulopathies and increasing the risk of thromboembolic events.[14,35] Although there are several other recommended explanations to justify the higher incidence of AIS in COVID-19 patients, a more common consensus was seen on these two reasons.[36]

An important point that should be considered in the management of these cases is the lack of current knowledge about COVID-19 management and treatment at the time of the event. Many potentially beneficial medications have been found in the years past since the occurrence of this case. For example, at the time of the occurrence of the narration, there were serious controversies about the effectiveness of using Remdesivir or IVIG as therapeutic options for COVID-19 infections. Moreover, considering the patient's medical condition and her hemodynamic instability, performing more frequent neurologic evaluations, such as brain MRI imaging, was impossible, and it may have caused a delay in the diagnosis of the neurologic condition.

TABLE 1 (Literature review table): post-COVID-19 cerebrovascular accidents in children.

Study and the first author	Presentation of the disease	Diagnostic measures and their results	Therapeutic measures and results
1. Stroke in a child with SARS-CoV-2 infection: A case report Khosravi et al.[13]	10-year-old female. Presented due to the sudden emergence of the following symptoms: bilateral shoulder and unilateral leg tonic movement (right), severe headache (right temporal), facial distortion, and loss of consciousness for 5 min. In the ED, she presented with dysarthria and left hemiparesis 1 week after COVID-19 symptoms	The PCR test for COVID-19 was positive. Brain MRI revealed infarction in the right putamen, globus pallidus, and posterior part of the insula. MRA revealed a minor focal narrowing in the right MCA	She was admitted to the hospital. The enoxaparin infusion started along with aspirin. Enoxaparin was stopped after 3 days, but aspirin has continued until now. Symptoms were resolved completely after receiving inpatient treatment
2. Acute ischemic stroke (AIS) in an infant with COVID-19 infection and delayed diagnosis of neurofibromatosis type 1, Akbar et al.[37]	6-month-old male. Presented with lethargy, eye blinking and eye flutter for a short period, right-sided twitching, right-side gaze, and irritability. Right-sided hemiparesis and café-au-lait spots were detected in the physical exam	A brain CT scan revealed a left MCA territory infarct, hypoplastic left transverse, and sigmoid sinus. The COVID-19 PCR test became positive. CT angiography revealed severe stenosis and subocclusive thrombosis in the mid-distal MCA. Brain MRI results: left hemisphere infarction due to the mass effect	IV unfractionated heparin (UFH) started after the AIS diagnosis. The seizure was not responsive to Keppra. Therefore, IV phenobarbital was started, which led to the cessation of the seizure. Symptoms have never been repeated until now
3. COVID-19 associated arterial ischemic stroke and multisystem inflammatory syndrome in children: a case report, Tiwari et al.[38]	9-year-old female. Throbbing frontal headache, vomiting, and unilateral progressive weakness on the right side from 5 days before presentation and 5 days after the start of high-grade fever. Bilateral non-purulent conjunctivitis, GCS of 11/15, right-sided facial nerve palsy, hemiplegia, brisk deep tendon reflex (DTR), and extensor plantar response on the right side	The COVID-19 PCR test was positive. In her lab data, high levels of ESR, D-dimer, CRP, triglyceride, and ferritin were detected. On CXR: bilateral ground-glass and reticulonodular opacities. Brain CT scan: evidence of infarction (multifocal discrete and confluent hypodensities) in the genu and adjacent body of the corpus callosum, mild edema, and mass effect over the lateral ventricle. CT angiography revealed multifocal stenosis of both intracranial internal carotid arteries, right MCA, and ACA. Diffuse narrowing of the two segment branches of both MCAs	Provided medical care: mechanical ventilation, antipyretics, sedation, and head-elevation to 30°; osmotherapy (glycerol, 3% hypertonic saline, and intermittent mannitol); intermittent hyperventilation; supportive care; and empirical antibiotics. Deterioration and cardiac arrest on Day 3 of PICU admission. IVIG, methylprednisolone, redeliver, and low-molecular-weight heparin were added to her treatment. Her clinical status improved progressively, and she was extubated and transferred to the ward for more supportive care and rehabilitation
4. Is a brain stroke caused by COVID-19 seen under 2 years of age? A case report, Vafaee-shahi et al.[39]	17-month-old female. She was brought to the ED with right-sided upper and lower limbs hemiparesis and focal status epilepticus for days after the start of diarrhea, nausea, vomiting, and a low-grade fever. Deviated right-side posture in a seated position, decreased right-sided muscle force, asymmetric plantar reflexes, and upward and brisk DTR on the right side	The COVID-19 PCR test was positive. A brain CT scan revealed left-sided wedge-shaped hypodensity and lower corticomedullary differentiation. Brain MRI showed AIS (high-signal intensity in the left MCA territory)	Inpatient medical treatment was provided with phenytoin, acyclovir, enoxaparin, and aspirin. The patient was discharged in good clinical condition

TABLE 1 (Continued)

Study and the first author	Presentation of the disease	Diagnostic measures and their results	Therapeutic measures and results
5. Post-COVID-19 ischemic stroke in a 15-year-old patient, AlKandari et al.[40]	15-year-old female. Presented with a history of facial asymmetry, right-sided unilateral upper and lower limbs, and decreased sensation a few days after the start of being unwell and low-grade fever. There is no history of COVID-19 vaccination. In her physical exam, dysarthria, unilateral right UMN facial weakness, diplopia affecting the left eye, right-sided hypertonia, hyperreflexia, ankle clonus, and declined right superficial sensations	Nasopharyngeal PCR was positive for COVID-19. A brain MRI showed AIS in the pons and left cerebellum. A brain CTA revealed occluded left vertebral and basilar arteries. In her lab data, a mildly elevated D-dimer was detected	Initially, IV methylprednisolone started due to the initial diagnosis of demyelinating syndrome, and after the AIS diagnosis, it stopped. Plavix and aspirin treatment began, and after 5 weeks, admission was referred for rehabilitation. Motor symptoms resolved partially, but the sensational disorder remained persistent—a significant motor improvement after physiotherapy, occupational therapy, and robotic hand rehabilitation therapy
6. Central retinal artery occlusion in a young child affected by COVID-19: a first case report, Abbati et al.[41]	6-year-old female. Unvaccinated for COVID-19. Presented with abrupt, painless, and complete bilateral vision loss, detected an hour before ED presentation after awakening. In her eye examination, she found bilateral nonreactive mydriasis, decreased visual acuity to a hand motion at 30 cm in the left eye, negative light perception in the right eye, as well as an ischemic retina and a cherry-red spot in the fovea of the right eye	Positive nasal swab PCR for COVID-19. There were no remarkable findings in brain CT, MRI, or MRA. Ophthalmoscopy revealed central retinal artery occlusion (CRAO). Optical coherence tomography (OCT) detected a bilateral macular thickness reduction. The CRAO diagnosis was confirmed with fluorescein angiography (revealing poor and delayed blood flow) and flash visual evoked potentials (VEP)	Treatment with inpatient low-molecular-weight heparin (LMWH) started along with an IV steroid and switched to oral prednisolone after 3 days. After 4 weeks, the LMWH infusion switched to an anti-thrombotic dose of aspirin. After eye rehabilitation, there was partial left-eye vision improvement to the extent of light perception and finger count at 30 cm. The right eye remained blind
7. a rare case report of acute neurologic sequelae in a young primigravida with recent COVID pneumonia, Hmaidan et al.[42]	16-year-old female. Unvaccinated against COVID-19. Presented with new-onset unilateral right-sided tremors and upper and lower limbs, urinary incontinence, generalized weakness, and generalized tonic-colonic seizure activity for roughly 90 s. A physical exam revealed bilateral extremity weakness (4/5) and hyperreflexia (4+)	Incidental positive pregnancy test and COVID-19 PCR test. CXR revealed patchy pulmonary opacities throughout the lungs, more prominent in the right lung. She was admitted to the ICU due to a bacterial superinfection with COVID-19 pneumonia. Frontally predominant generalized periodic discharges and left hemispheric voltage attenuation were obvious on her electroencephalogram (EEG). In brain MRI, restricted bilateral parafalcine diffusion was seen	In her first admission to supportive care, IV broad-spectrum antibiotics, dexamethasone, and remdesivir were started in the ICU for 4 days and discharged after 7 days. In the second admission, an IV transfusion of Ativan was initiated for the abortion of seizure activity, and magnesium was also administered. Prophylactic levetiracetam after EEG. Transferred to the ICU and intubated due to advancing dysarthria and dysphagia. Diffusion-weighted MRI revealed bilateral restricted ACA territory diffusion and cortical insula. Urgent cesarean due to the instability of the patient's condition. Treatment proceeded with the diagnosis of reversible cerebral vasoconstriction syndrome (RCVS). After extubating, temporary delirious symptoms were seen, and a six-month follow-up demonstrated almost full recovery with minor neurologic deficits

(Continues)

TABLE 1 (Continued)

Study and the first author	Presentation of the disease	Diagnostic measures and their results	Therapeutic measures and results
8. Cerebrovascular accident in a child with precursor B-cell acute lymphoblastic leukemia and coronavirus disease 2019: a case report, Karimi et al.[43]	6-year-old female. History of pre-B-cell acute lymphoblastic leukemia. Presented to the ED due to fever irresponsive to symptomatic treatment for COVID-19 for 3 days. On the third day of admission, along with hypoxemia, recurrent episodes of seizures occurred. A unilateral left-sided lower limb neurologic deficit and impairment of speech were seen after extubation in the PICU	Her index laboratory test showed a low absolute neutrophil count (ANC < 500/μL), lower than normal for all blood cell precursors. A brain CT scan after the CT revealed the right parietal lobe AIS, causing edema and a midline shift of the brain. Positive nasal and CSF PCR for COVID-19. A progression of thrombotic lesions after extubation was seen in the brain CT scan. Superimposed pneumonia was seen in the post-discharge chest CT scan	Intravenous vancomycin and meropenem infusions started after the detection of low ANC. IV midazolam on the third admission day to control seizures. Treatment with IV dexamethasone and hypertonic mannitol to decline the ICP. Phenytoin and levetiracetam controlled the seizure. Heparin, remdesivir, and vitamins A, B, and C were added to her therapeutic regime. IV inpatient antibiotic treatment superimposed pneumonia. Speech and physiotherapy led to the patient's full recovery in a 10-month follow-up

4 | CLINICAL KEY POINT (CONCLUSION)

In the presented case, COVID-19 pneumonia and its resultant superinfection with Acinetobacter seem to contribute to the AIS occurrence. Due to the severity of both respiratory involvement and brain damage, the medical and surgical interventions were fruitless, and the patient expired after 15 days of admission to the PICU. Physicians are advised to consider stroke a probable complication of infections, especially pneumonia, and be sensitive to any suspicious symptom or sign. Moreover, for selected patients, preventive measures such as anticoagulant prescriptions for pediatrics with severe infections might be a legitimate choice. Finally, parents should be encouraged to seek treatment for their children's infectious diseases actively. As seen in this case, late presentation might lead to the progression of the disease and surpass the unreversible border. In cases of late presentation, the physician should keep child neglect in mind, and appropriate investigations are encouraged in such cases.

AUTHOR CONTRIBUTIONS

Fahimeh Ehsanipur: Conceptualization; data curation; formal analysis; resources; software; supervision; validation. **Pouya Ebrahimi:** Investigation; methodology; project administration; visualization; writing – original draft; writing – review and editing. **Leila Tahernia:** Investigation; methodology; project administration; visualization; writing – original draft; writing – review and editing. **Mohammad Vafaee-Shahi:** Conceptualization; data curation; formal analysis; resources; software; supervision; validation.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest in preparing this case presentation.

DATA AVAILABILITY STATEMENT

Further Data will be provided by the corresponding author in case of reasonable request.

ETHICS APPROVAL

This case study was accredited by the Ethical Committee of Iran University of Medical Sciences.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

CONSENT TO PUBLISH

Since this study is a case report, no identifiable information is included in this study, and it was exempted from the ethical code by the Institute of Endocrinology and Metabolism, Iran University of Medical Sciences. However, written informed consent was obtained from the patient's parents for publication of this case report and any accompanying images. A copy of the written consent was uploaded to the editorial manager of this journal.

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