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COVID-19; Neurological Findings in Five Pediatric Patients

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Abstract

Neurological involvement in the coronavirus disease 2019 (COVID-19) infection is increasing all over the world. Neurological manifestations include headache, dizziness, stroke, seizure, encephalopathy, neuropathy, and skeletal muscle injury. While many patients with central nervous system involvement have normal neuroimaging, some show significant abnormalities. In this article, we report five patients with neurological manifestations of COVID-19 infection and its relevant abnormalities in brain magnetic resonance imaging.

Keywords: COVID-19; Pediatrics; Neurology; Brain magnetic resonance imaging.

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Introduction

Although pulmonary involvements are the main manifestations of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, neurological complications have also been reported recently. Coronavirus disease 2019 (COVID-19) can influence the central nervous system (CNS) via cerebral spinal fluid, olfactory and trigeminal nerves, the lymphatic system, or hematogenously and cause several neurological manifestations. Encephalopathy, encephalitis, ischemic stroke, inflammatory demyelination, anosmia, dysgeusia, headache, nausea, vomiting, seizure, and peripheral neurological disorders have been reported.

Angiotensin convertase enzyme 2 (ACE2) is a cellular receptor for the new coronavirus. This receptor is present in multiple human organs including the brain and glial tissue and this makes the CNS a potential target.[1] The diagnosis of COVID-19 infection is based on reverse-transcription polymerase chain reaction (RT-PCR) test and detection of lesions by computed tomography (CT) scan of the chest.[2] Neurological complications in children with COVID-19 infection have been recently reported. In this article, we report five cases of COVID-19 PCR-positive children with neurological manifestations and abnormal neuroimaging.

Case Presentation

Case 1: A 12-year-old girl with fever and intractable convulsions was admitted to the pediatric department. In further assessments, lymphopenia and transaminitis were detected. because of an unstable situation, a lumbar puncture was not done. Lung HRCT and brain magnetic resonance imaging (MRI) were abnormal and COVID-19 PCR was positive. The patient died after two weeks. Brain MRI was consistent with acute infarctions in bifrontal and biparietal lobes (Figure 1).

Case 2: A 7-year-old boy was admitted with fever, ataxia, and drowsiness. He had no respiratory symptoms and laboratory data were normal. A lumbar puncture was done and no abnormality was detected. The family history of COVID-19 was positive. lung HRCT was normal but COVID-19 PCR was positive. The patient recovered after several days with no complications. Brain MRI revealed hyperintense signals in the brain stem and deep gray matter (Figure 2).

Case 3: A 4-year-old girl was admitted with dyspnea, fever, and generalized skin rashes. She was intubated because of a low level of consciousness and dyspnea. Lung HRCT involvement was typical for COVID-19 and PCR was positive. after extubation she had weakness of lower limbs and walking disability. She completely recovered after 2 weeks. Brain MRI demonstrates a small ischemic area in the left centrum semi-oval (Figure 3).

Case 4: A 9-year-old boy was admitted because of fever, seizure, severe headache, and neck stiffness. Lumbar puncture revealed 120 *white blood cells* with

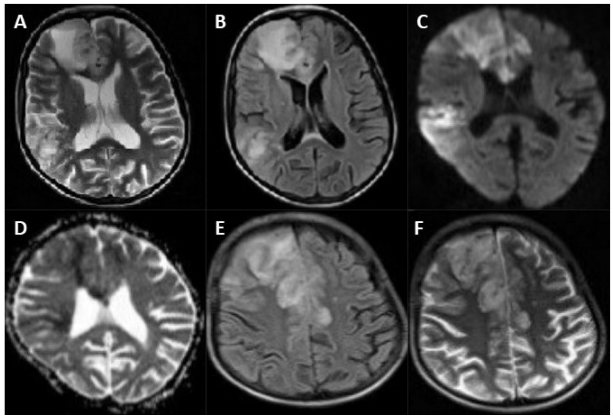

Figure 1. (A, B) axial T2 and flair brain MRI reveal hyperintensities in the right frontal and parietal regions. (C, D) DWI brain MRI shows restriction diffusion in the affected area which reveals acute stroke in the bifrontal lobes besides the right parietal lobe. E, F) axial flair and T2 brain MRI reveal hyperitensities in the right frontoparietal lobe.

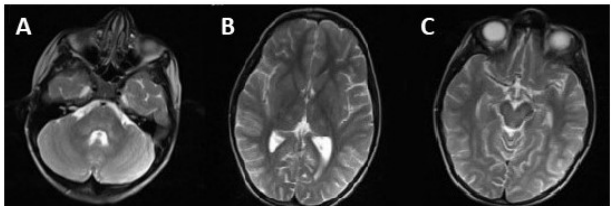

Figure 2. T2 axial brain MRI reveals; (A) hyperintense signals in bilateral dentate nuclei and pons; (B) hyper signal intensities in bilateral thalamic regions; (C) midbrain involvement.

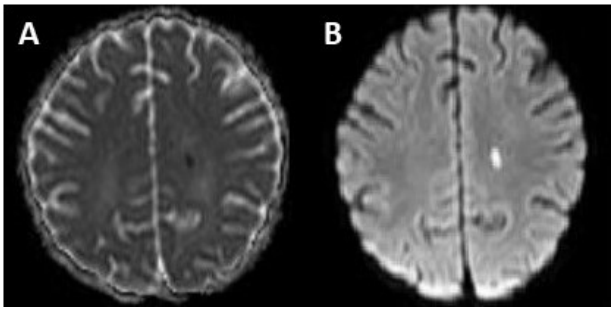

Figure 3. The axial sequence of DWI and ADC map shows restriction diffusion in the left centrum semiovale region.

80% lymphocyte. COVID-19 PCR was positive. Brain MRI revealed bilateral scattered subcortical white matter involvement. Four days after admission, patient's general health improved. In follow-up one month later, he had occasional headaches (Figure 4).

Case 5: A five-month-old girl was admitted because of fever and severe gastroenteritis. PCR for COVID-19 was positive. She was complicated by intractable seizures. Brain CT scan revealed intraventricular hemorrhage. Multiple ischemic regions were demonstrated in brain MRI images. Due to some problems we could not contact the patient and do the follow-up (Figure 5).

Discussion

Different neurological involvements in children have been reported all over the world with COVID-19. However, neuroimaging data about this topic is limited. CNS manifestations of coronavirus have been reported in more than 30% of the patients who were in a critical situation.[3] Neuronal destruction in the base of the inflamed brain parenchyma has been detected in the postmortem studies.[4] Because of a hyper inflammatory response and the direct virus cytopathic injury, cytokine storm may cause neurological involvements such as encephalitis, acute flaccid myelitis, or acute necrotizing encephalopathy of childhood (ANEC) in pediatrics.[5] 5-5.7% of patients with COVID-19 who had neurological manifestations were complicated with ischemic or hemorrhagic cerebrovascular disease.[6] According to the literature, the most common neuro-radiological findings in patients with mild to severe pulmonary involvements were ischemic stroke and abnormal white matter signal intensities while hemorrhagic events were more prominent in severe form of pulmonary infection.[7] Loss of consciousness and ischemic hemorrhagic cerebrovascular events were the most prevalent neurological complications in adults complicated with severe form of COVID-19 infection.[8-10] Involvement of central and peripheral nervous systems even in the absence of respiratory symptoms have been reported in children.[11] Ischemic stroke may be due to a hypercoagulable state caused by the virus since in both cases of severe and mild COVID-19

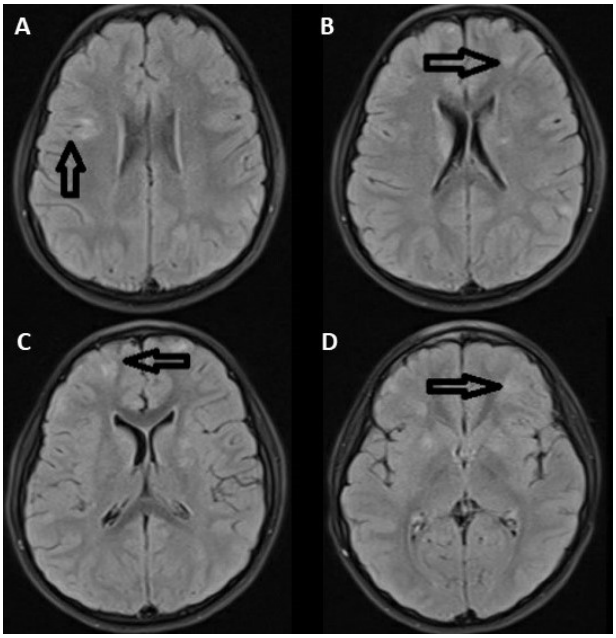

Figure 4. Several Cortical and Subcortical Involvements (Black Arrows).

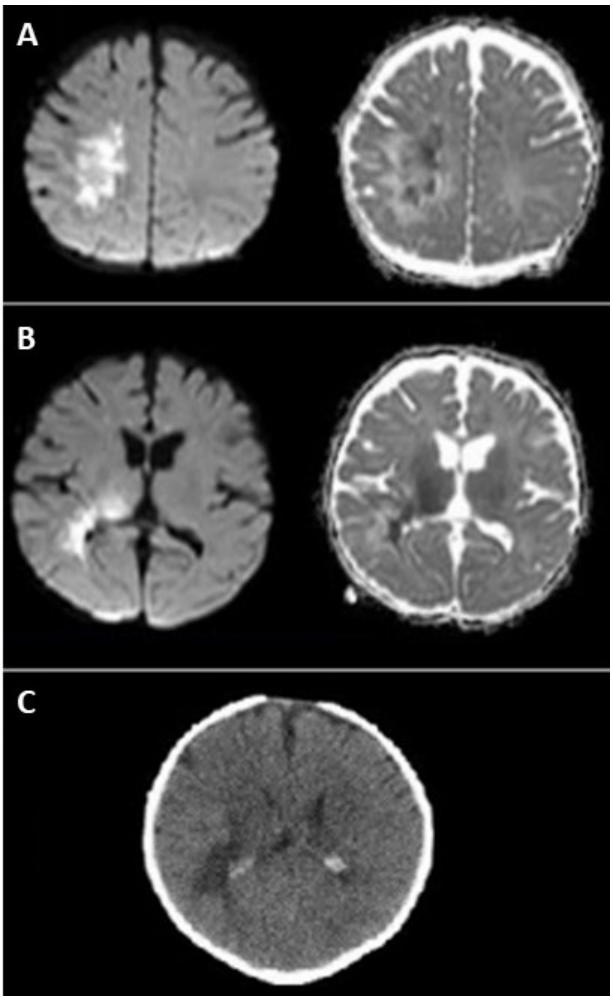

Figure 5. (A) Right sentrum semioval is affected. (B) brain MRI reveals restriction diffusion in the right posterior periventricular region and thalamus. (C) brain CT scan reveals intraventricular hemorrhage.

infection, cerebral infarction was commonly reported.[7,12]

Conclusion

Attention to limited data and more investigation are needed to evaluate long-term neurological impairments related to COVID-19 infection. More investigation is necessary to answer unsolved questions.

Since COVID-19 is mostly known for its respiratory complications, neurological and neuroradiological manifestations of COVID-19 may not be noticed. Thus, it is important to be alert about different neurological and neuroradiological symptoms of COVID-19.

Conflict of Interest

The authors declare that they have no conflict of interests.

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Authors' Contribution

JA and FA collected the data about the patients and reviewed the final article. FST reported and explained the MRI scans. NH and SZ have put all the data together and written the article.

Ethical Statement

Informed consent was obtained from the parents of patients for publication of this report.

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