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Psychosis After Infection With SARS-CoV-2 in an Adolescent: A Case Report

To the Editor:

As many as one-third of patients who have COVID-19 develop long-term neuropsychiatric symptoms, such as anxiety, depression, brain fog, psychosis, seizures, and suicidal behavior.1 Several case reports have demonstrated the association between psychotic symptoms following infection with COVID-19 in adults.1,2 In a first episode of psychosis, clinical findings on history, examination, and diagnostic studies may suggest that the psychotic symptoms are due to medical illness, which may be reversible. The presentation can include acute onset, predominance of visual or tactile hallucinations, and association with other neurological symptoms.3

We present the case of an adolescent girl who developed an acute episode of psychosis after infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). She presented with psychosis soon after COVID-19 infection. Her laboratory tests were nonrevealing. She responded to olanzapine and was discharged within 5 days. It is important to recognize neuropsychiatric symptoms secondary to COVID-19 in the pediatric population.

CASE REPORT

A 15-year-old girl with no past psychiatric history and no significant family history was brought by her mother to the local emergency department for odd behavior. She had experienced difficulty sleeping for the past 3 days, and earlier that day she had begun acting erratically, telling others that it was time for her to die and complaining of seeing and feeling bugs in her hair. In the parking garage, she fell to the floor and exhibited seizure-like activity for approximately 2 minutes. Her mother reported that she and the rest of the family had been infected with coronavirus disease 2019 (COVID-19) approximately 2.5 weeks prior. The patient family had been infected with coronavirus disease 2019 (COVID-19) approximately 2.5 weeks prior. The patient had been treated with dexamethasone 4 mg for 5 days, which was finished 1 week before presentation without any ill effects. It is uncertain whether the patient’s family members had received any type of steroid treatment. Nonetheless, the

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### TABLE 1 Laboratory Results From the Community Emergency Department and Johns Hopkins All Children’s Hospital

| Laboratory test | Result | Result |
|-----------------|--------|--------|
| **Community emergency department** |       |        |
| β-HCG           | Negative |        |
| SARS-CoV-2 rapid antigen | Negative |        |
| Complete blood count |       |        |
| White blood cells, 10^9/L   | 7.8 |        |
| Red blood cells, 10^12/L    | 4.29 |        |
| Hemoglobin, g/dL            | 12.6 |        |
| Hematocrit, %               | 39.2 |        |
| Platelet count, 10^9/L       | 271 |        |
| Lymphocytes, %              | 24 (low) |        |
| Neutrophils, %              | 64 |        |
| Monocytes, %                | 12 (high) |        |
| Eosinophils, %              | 0 (low) |        |
| **Comprehensive metabolic panel** |       |        |
| Sodium, mEq/L             | 141 |        |
| Potassium, mEq/L          | 3.5 |        |
| Chloride, mmol/L         | 111 (high) |        |
| Carbon dioxide, mmol/L   | 25 |        |
| BUN, mg/dL                | 9 |        |
| Creatinine, mg/dL         | 0.74 |        |
| Glucose, mg/dL            | 95 |        |
| Calcium, mg/dL            | 9.4 |        |
| Magnesium, mg/dL          | 2.2 |        |
| Total bilirubin, mg/dL    | 0.7 |        |
| Aspartate aminotransferase, IU/L | 19 |    |
| Alanine aminotransferase, IU/L | 27 |    |
| Alkaline phosphatase, IU/L | 69 |    |
| Total protein, g/dL       | 7.9 |        |
| Albumin, g/dL             | 3.5 |        |
| Globulin gap, g/dL        | 4.4 (high) |        |
| Lipase, U/L               | 68 |        |
| Creatine kinase, U/L      | 78 |        |
| Ethyl alcohol, mg/dL      | <3.0 |        |
| **Urinalysis**            |       |        |
| Protein, mg/dL            | 100 |        |
| Ketones, mg/dL            | 5 |        |
| Nitrite                    | Positive | 4.0 |
| Urobilinogen, mg/dL       | Trace |        |
| Leukocyte esterase, Leu/μL | Moderate |         |
| Total protein, g/dL       | 7.9 |        |
| Albumin, g/dL             | 3.5 |        |
| Globulin gap, g/dL        | 4.4 (high) |        |
| **Johns Hopkins All Children’s Hospital** |       |        |
| C-reactive protein, mg/dL | 0.03 |        |
| **Urine drug screen**     |       |        |
| Opiates                    | Negative |        |
| Methadone                  | Negative |        |
| Phencyclidine              | Negative |        |
| **Johns Hopkins All Children’s Hospital** |       |        |
| Amphetamines               | Negative |        |
| Benzodiazepines            | Negative |        |
| Cocaine                    | Negative |        |
| Marijuana                  | Negative |        |
| Troponin I, ng/mL          | <0.04 |        |
| **C-reactive protein, mg/dL** | 0.03 |      |
| **Urine drug screen**     |       |        |
| Opiates                    | Negative |        |
| Methadone                  | Negative |        |
| Phencyclidine              | Negative |        |
| **Comprehensive metabolic panel** |       |        |
| Sodium, mEq/L             | 141 |        |
| Potassium, mEq/L          | 3.5 |        |
| Chloride, mmol/L         | 111 (high) |        |
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| BUN, mg/dL                | 9 |        |
| Creatinine, mg/dL         | 0.74 |        |
| Glucose, mg/dL            | 95 |        |
| Calcium, mg/dL            | 9.4 |        |
| Magnesium, mg/dL          | 2.2 |        |
| Total bilirubin, mg/dL    | 0.7 |        |
| Aspartate aminotransferase, IU/L | 19 |    |
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| Ketones, mg/dL            | 5 |        |
| Nitrite                    | Positive | 4.0 |
| Urobilinogen, mg/dL       | Trace |        |
| Leukocyte esterase, Leu/μL | Moderate |         |
| Total protein, g/dL       | 7.9 |        |
| Albumin, g/dL             | 3.5 |        |
| Globulin gap, g/dL        | 4.4 (high) |        |
| **Johns Hopkins All Children’s Hospital** |       |        |
| C-reactive protein, mg/dL | 0.03 |        |
| **Urine drug screen**     |       |        |
| Opiates                    | Negative |        |
| Methadone                  | Negative |        |
| Phencyclidine              | Negative |        |
| **Comprehensive metabolic panel** |       |        |
| Sodium, mEq/L             | 141 |        |
| Potassium, mEq/L          | 3.5 |        |
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| Lipase, U/L               | 68 |        |
| Creatine kinase, U/L      | 78 |        |
| Ethyl alcohol, mg/dL      | <3.0 |        |
| **Urinalysis**            |       |        |
| Protein, mg/dL            | 100 |        |
| Ketones, mg/dL            | 5 |        |
| Nitrite                    | Positive | 4.0 |
| Urobilinogen, mg/dL       | Trace |        |
| Leukocyte esterase, Leu/μL | Moderate |         |
| Total protein, g/dL       | 7.9 |        |
| Albumin, g/dL             | 3.5 |        |
| Globulin gap, g/dL        | 4.4 (high) |        |
| **Johns Hopkins All Children’s Hospital** |       |        |
| C-reactive protein, mg/dL | 0.03 |        |
| **Urine drug screen**     |       |        |
| Opiates                    | Negative |        |
| Methadone                  | Negative |        |
| Phencyclidine              | Negative |        |

(continued)
patient was the only one of her family who presented with hallucinations. Initial laboratory tests including urine drug screen were negative (Table 1). While in the emergency department, the patient was alert and oriented but continued to experience paranoia, delusions, and hallucinations. She did not display any fluctuation in cognition, attention, or arousal. Psychiatric consultation was obtained, and the consulting physician recommended that further neurological workup, including lumbar puncture, be performed. The patient had an episode of agitation in which she reported hallucinations as well as anxiety and attempted to elope despite attempts at redirection. After receiving haloperidol for agitation, she was transferred to Johns Hopkins All Children’s Hospital for further care.

At Johns Hopkins All Children’s Hospital, her bizarre behavior persisted. She was suspicious of staff and appeared internally preoccupied. She began to ask permission excessively of her mother for meals and toileting. She described persistent hallucinations and delusions of reference. An additional 2.5 mg was added in the morning within 2 days for an episode of paranoia after she attempted to stab the hospital sitter with a spoon. Her

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**TABLE 1 Continued**

| Laboratory test                              | Result       |
|----------------------------------------------|--------------|
| Influenza A                                  | Negative     |
| Influenza B                                  | Negative     |
| Parainfluenzae 1                            | Negative     |
| Parainfluenzae 2                            | Negative     |
| Parainfluenzae 3                            | Negative     |
| Parainfluenzae 4                            | Negative     |
| Respiratory syncytial virus                 | Negative     |
| Bordetella pertussis                        | Negative     |
| Bordetella parapertussis                    | Negative     |
| Chlamydia pneumoniae                        | Negative     |
| Mycoplasma pneumoniae                       | Negative     |
| Encephalitis panel (serum)                  |              |
| AMPA-R antibody                             | Negative     |
| Amphilphysin antibody                       | Negative     |
| AGNA-1                                       | Negative     |
| ANNA-1                                       | Negative     |
| ANNA-2                                       | Negative     |
| ANNA-3                                       | Negative     |
| CASPR2-immunoglobulin G                    | Negative     |
| CRMP-5-immunoglobulin G                    | Negative     |
| DPPX Ab IFA                                 | Negative     |
| GABA-B-R antibody                           | Negative     |
| GAD65 antibody                              | Negative     |
| GFAP                                         | Negative     |
| IgLON5                                       | Negative     |
| LGI1-immunoglobulin G                       | Negative     |
| mGluR1 antibody                              | Negative     |
| NIF                                          | Negative     |
| NMDA-R antibody                             | Negative     |
| PCA-1                                        | Negative     |
| PCA-2                                        | Negative     |
| PCA type Tr                                 | Negative     |
| Cerebrospinal fluid results                 |              |
| Volume                                       | 2 mL         |
| Color                                        | Colorless    |
| Glucose, mg/dL                              | 66           |
| Protein, mg/dL                              | 20           |
| Red blood cells, per mm$^3$                  | 218          |
| White blood cells, per mm$^3$                | 2            |
| Meningitis panel                            |              |
| Escherichia coli                            | Negative     |
| Haemophilus influenzae                      | Negative     |
| Listeria monocytogenes                      | Negative     |
| Neisseria meningitidis                      | Negative     |
| Streptococcus agalactiae                    | Negative     |
| Streptococcus pneumoniae                    | Negative     |
| Cytomegalovirus                              | Negative     |
| Enterovirus                                 | Negative     |
| Herpes simplex virus type 1                 | Negative     |
| Herpes simplex virus type 2                 | Negative     |
| Human herpesvirus 6                         | Negative     |

(continued)
symptoms improved, and she was discharged home within 5 days. At a follow-up appointment 1 week after discharge, her symptoms had all but resolved. As she continued to stabilize, the plan had been to gradually wean off olanzapine over the course of 6 months as tolerated. However, she was lost to follow-up.

DISCUSSION

There is limited information about the neuropsychiatric impact of COVID-19 infection in the pediatric population. In adults, neuropsychiatric symptoms associated with COVID-19 such as psychosis typically occur within days to weeks after the infection.2 Children and adolescents have similarly shown that most neuropsychiatric symptoms develop after the acute respiratory infection resolves.3 Our case adds to the emerging body of data on neuropsychiatric symptoms in youth with COVID-19 infection.

This patient had no past psychiatric history, and her presentation was not consistent with delirium, as she did not have disturbance in attention, awareness, or cognition. Although she received a short course of low-dose dexamethasone before the presentation of psychotic symptoms, there were no psychotic symptoms during the dexamethasone treatment. Additionally, she had completed the dexamethasone treatment more than 1 week before the onset of her psychotic symptoms, making the steroid exposure an unlikely cause of her symptoms.5 Given that COVID-19 infection preceded the psychotic symptoms by 2 weeks, the remaining explanation was psychosis secondary to COVID-19 infection.

A notable strength of this case report is the thorough medical evaluation the patient received. Given her abrupt presentation of psychosis, she appropriately had a comprehensive medical workup for secondary causes of psychosis, and these were all negative or normal. While the neuropsychiatric symptoms of COVID-19 are typically thought to be due to inflammation, others have reported cases of adults in which inflammatory markers are normal, and the same has been seen in some cases of anti-N-methyl-D-aspartate receptor encephalitis.6 One case series also described a teenager with psychosis after infection with COVID-19 who had normal serum inflammatory markers.7 One possibility is that symptoms were mediated by a specific antibody or antibodies that are not routinely tested, such as those proposed by Bartley et al.7 This may be one possible explanation for her elevated globulin gap.

This report has limitations. As a single case report, there is no comparison or control group. Causation cannot be definitively linked to infection with COVID-19. While many antibodies were tested in this patient, some specific antibody tests performed in other research studies were not available to perform.

This case highlights the potential for neuropsychiatric sequelae from COVID-19 infection in the adolescent age group. It is important for clinicians to recognize that such complications can arise in youth affected by COVID-19 so that treatment can be guided appropriately.

PATIENT PERSPECTIVE

With the medication, I felt like my body was able to work for me again. I was no longer seeing anything in the dark. I was no longer hallucinating.

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Accepted March 2, 2022.
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The authors have reported no funding for this work.
Consent has been provided for descriptions of specific patient information.

All statements expressed in this column are those of the authors and do not reflect the opinions of the Journal of the American Academy of Child and Adolescent Psychiatry. See the Guide for Authors for information about the preparation and submission of Letters to the Editor.