LETTER TO THE EDITORS

Acute necrotizing myelitis and acute motor axonal neuropathy in a COVID-19 patient

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Abstract
A 61-year-old woman with COVID 19 infection developed acute necrotizing myelitis (ANM) and acute motor axonal neuropathy (AMAN), a rare variant of Guillain-Barré syndrome (GBS) without systemic signs of infection. MRI of the cervical spine demonstrated longitudinally extensive transverse myelitis, and EMG was consistent with the diagnosis of AMAN. CSF testing was negative for SARS-CoV-2. High dose steroids followed by plasma exchange were administered, and the patient made a clinical recovery. Immunotherapy has some role in fastening the improvement of immune-mediated neurological conditions associated with COVID-19.

Keywords SARS-CoV2 · ANM · GBS · Post-infectious · Inflammation

Dear Sirs,

The variety of neurological disorders described in COVID-19 could be attributed to one of several mechanisms of injury that have been described with other viral infections such as herpes simplex infections [1]. There are several mechanisms involved for viral dissemination to the nervous system, including direct binding of the virus to the ACE2 receptors expressed in the nasal epithelium or the olfactory bulb through a retrograde trans-synaptic mechanism, hematogenous, lymphatic and migration of infected immune cells. The critical test required for confirmation of the CNS infection by SARS-CoV-2 is the detection of its RNA by RT-PCR in the CSF. However, the sensitivity of the CSF SARS-CoV-2 RT-PCR is unknown. Here we present a unique case of COVID 19 patients with acute necrotizing myelitis (ANM) and acute motor axonal neuropathy (AMAN), a rare variant of Guillain-Barré syndrome (GBS) without systemic signs of infection.

A 61-year-old right-handed woman with a history of hypertension, hyperlipidemia, hypothyroidism, and a remote history of nasopharyngeal and uterine cancer presented to the emergency department with progressive weakness. Two weeks before her presentation, she had contact with a COVID-19 positive coworker. A week before her presentation, she developed a runny nose and chills. She had no fever, cough or shortness of breath. Three days before her admission, she started experiencing a tingling sensation in her fingers and toes. Over the next day, symptoms progressed, and she lost feeling from the chest down and developed progressive weakness in her extremities, and lost her ability to walk. She has not had a bowel movement in a week and developed bladder retention. Neurological examination showed increased tone in the lower extremities with weakness in the upper and lower extremities, worse in the lower extremities. Reflexes were normal in the upper extremities but brisk in the lower extremities with upgoing toes bilaterally. The patient had a sensory level at C3. Nasopharyngeal SARS-CoV2 RT-PCR was positive. COVID labs were all within the normal range (Appendix).

Brain MRI was normal. However, MRI Cervical spine showed patchy T2 hyperintensities within the central cord extending from below the foramen magnum, proximal...
C1-C2, to cervicothoracic junction (Fig. 1a–c), with spinal cord slightly increased in overall caliber at C3 and C4, and patchy enhancement obscured by the motion artifact (Fig. 1e). These changes were associated with a slight hypointense signal on the T1 images at the C2–C3 level (Fig. 1d). MRI thoracic and lumbar spine were normal. The patient had an extensive diagnostic work up, which was negative for nutritional deficiencies, infectious, autoimmune diseases (Lupus, Sjogren’s vasculitis, syphilis, aquaporin-4 and myelin oligodendrocyte glycoprotein antibodies). Aquaporin-4 antibody tested negative in both CSF and serum.

The patient had a spinal fluid analysis that showed a hemorrhagic tap (red blood cells 312/mm³) with normal white blood cells (3/mm³) elevated protein (87 mg/dl) and glucose (73 mg/dl). CSF IgG index was normal (0.7), and no oligoclonal bands were present. CSF gram stain and culture was negative. CSF VDRL was negative. CSF viral PCR for other microbes was recommended by the neurology team but was not collected. CSF testing for SARS-CoV-2 was negative. CSF paraneoplastic panel (Mayo clinic, appendix) was also negative. The patient was treated with methylprednisolone 1 g IV for 5 days without improvements. The patient continued to progress and became quadriplegic. On neurological re-evaluation, 3 weeks after her initial onset of symptoms, the patient was found to be areflexic in all extremities. She had a repeat spinal tap (10 days after the first one) and an EMG performed (3 weeks after her initial presentation) to evaluate for GBS. Repeat spinal fluid analysis demonstrated albuminocytological dissociation with elevated CSF protein (153 mg/dl) and normal white blood cell count (2/mm³), red blood cells (4/mm³), and glucose (79 mg/dl). EMG showed evidence of acute motor axonal neuropathy with normal sensory conductions (supplementary table).

The patient received five rounds of plasma exchange and was discharged to an inpatient rehabilitation facility. She started to make some clinical recovery 4–5 weeks after her clinical presentation. The patient started to stand up

![Fig. 1](image1) Cervical spine MRI with LETM STIR and Sagittal and Axial T2-FLAIR (a–c) and sagittal T1 (d) and postcontrast T1-weighted (e). A LETM is seen in the central cervical spinal cord (a–c) with subtle patchy enhancement hampered by the motion artifact (e, white arrow). Spinal cord swelling is seen at C3–C4 level with associated T1 hypointensity (d, white arrow). STIR Short inversion-time inversion recovery, FLAIR Fluid-attenuated Inversion Recovery, LETM Longitudinal extensive transverse myelitis
with the assistance and was able to take few steps with the walker at the rehabilitation facility.

Acute necrotizing encephalitis, myelitis and variants of GBS such as axonal, demyelinating, and Miller Fisher Syndrome have been reported with the COVID 19 [2–5]. Here we present the first case of COVID 19 patients who presented with GBS and ANM at the same time without any systemic manifestation. In most of these cases, SARS-CoV-2 RT-PCR was positive in the nasopharyngeal swab but negative in the CSF; including our case. All patients made a clinical recovery after immunotherapy. Form these cases; we learn that the immunotherapy has some role in fastening the improvement of immune-mediated neurological conditions associated with COVID-19.

**Funding** Not applicable.

**Compliance with ethical standards**

**Conflicts of interests** None of the authors have any conflicts of interests.

**Informed consent** Waiver for consent, Consent is not needed for the case report per IRB.

**Availability of data and material** Available upon request.

### Appendix

#### Laboratory test results

Sodium – 134 (135–145 mmol/L).
Potassium—4.2 (3.5–5.0 mmol/L).
Creatinine- 0.67 (< 1.13 mg/dL).
Blood urea nitrogen − 14.4 (10–25 mg/dL).
Liver function test – Normal.
CPK -205 (< 250 IU/L).
Lactate -1.5 (< 1.6 mmol/L).
White blood cell count- 11.3 (3.8–10.6 K/ul).
Hemoglobin- 14.1 (13.5–17.0 g/dL).
Platelets – 240 (100–300 K/ul).
TSH – 2.7 (0.45–5.33 uIU/mL).
Free T4 -1.28 (0.61–1.44 ng/dL).
Cholesterol -205 (< 200 mg/dL).
B Lymphocyte < 339 (> 180 pg/mL).
ANA titer 1: 80.

**Double-stranded DNA- Negative.**

**ENA- Negative.**

**Myeloperoxidase antibody- Negative.**

**C-ANCA and P-ANCA- Negative.**

#### CSF paraneoplastic panel

| Value | Comment |
|-------|---------|
| SEEBELOW | Test Result Flag Unit Ref Value |
| Encephalopathy–Autoimmune Eval. | Encephalopathy–Interpretation, CSF |
| No informative autoantibodies were detected in this evaluation. However, a negative result does not exclude autoimmune encephalopathy, idiopathic or paraneoplastic |
| Sensitivity and specificity of antibody testing are enhanced by testing both serum and CSF |
| AMPA-R Ab CBA, CSF Negative |
| Negative |
| Titer < 1:2 |
| ANNA-1, CSF Negative |
| Titer < 1:2 |
| ANNA-2, CSF Negative |
| Titer < 1:2 |
| ANNA-3, CSF Negative |
| Titer < 1:2 |
| AMPA-IgG CBA, CSF Negative |
| Titer < 1:2 |
| DiA Ab IFA, CSF Negative |
| GABA-A-R Ab CBA, CSF Negative |
| Titer < 1:2 |
| GAD65 Ab Assay, CSF 0.00 nmol/L | 0.02 |
| GSG IFA, CSF Negative |
| LGI1-IgG CBA, CSF Negative |
| Titer < 1:2 |
| mGluR1 Ab IFA, CSF Negative |
| PCA-Tr, CSF Negative |
| Titer < 1:2 |
| PCA-1, CSF Negative |
| Titer < 1:2 |
| PCA-2, CSF Negative |
| Titer < 1:2 |

**Laboratory Notes**

This test was developed and its performance characteristics determined by Mayo Clinic in a manner consistent with CLIA requirements. This test has not been cleared or approved by the U.S. Food and Drug Administration.

Test performed at Mayo Clinic Laboratories—Rochester Main Campus

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