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Acute transverse myelitis progressing to permanent quadriplegia following COVID-19 infection

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ARTICLE INFO

Article history:

Received 2 February 2022

Received in revised form 11 February 2022

Accepted 14 February 2022

Keywords:

COVID-19

Transverse myelitis

Quadriplegia

ABSTRACT

As of January 2022, there have been over 350 million confirmed cases of COVID-19 in the world. The most common symptoms in those infected are fever, cough, malaise, and myalgia, however pulmonary, hematologic, gastrointestinal, renal, and neurologic complications have also been reported. Acute transverse myelitis (ATM) is an uncommon neurological syndrome characterized by acute or subacute spinal cord dysfunction that can lead to paresthesias, sensory and autonomic impairment, and even paralysis. Etiologies are often unclear; however, potential causes include infection, neoplastic, drug or toxin induced, autoimmune, and acquired. Treatment for ATM primarily consists of steroids and plasmapheresis, which often reverses any neurologic symptoms. ATM has rarely been reported as a complication of COVID-19 infections.

A 43-year-old female presented to the emergency department for evaluation of progressive numbness and tingling in her legs ten days after developing upper respiratory symptoms from a COVID-19 infection. Physical examination and magnetic resonance imaging confirmed a diagnosis of ATM. During her hospital course, she experienced rapid progression of her paresthesias and developed complete loss of motor function in her upper and lower extremities. Within 48 hours after emergency department arrival, she required intubation due to worsening diaphragmatic and chest wall paralysis. Her treatment included a long-term steroid regimen and plasmapheresis, and unfortunately, she did not have any neurologic recovery. We present a very rare case of ATM progressing to complete quadriplegia following COVID-19 infection.

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1. Introduction

As of January 2022, there have been over 350 million confirmed cases of COVID-19 in the world [1]. The most common symptoms in those infected are fever, cough, malaise, and myalgia, however pulmonary, hematologic, gastrointestinal, renal, and neurologic complications have also been reported [2]. Overall, the mechanisms behind these complications are poorly understood and treatment options are still being studied. We report an extremely rare case of a female who contracted COVID-19 and developed transverse myelitis leading to permanent complete quadriplegia.

2. Case presentation

A 43-year-old female with no significant past medical history presented to the emergency department (ED) in November 2021 for

evaluation of numbness and tingling in her legs. Her symptoms began earlier that morning and were progressing proximally from her feet. She was able to ambulate to a wheelchair in the waiting room and also noted feeling generally weak. She reported testing positive for COVID-19 ten days prior to ED presentation with mild symptoms including a dry cough and weakness. She denied difficulty breathing or swallowing, fever, chills, and urinary or fecal incontinence. The patient was unvaccinated against COVID-19.

Physical exam at that time was remarkable for subjective decreased sensation from thighs down to her toes and full strength in the hip, knee, and ankle joints. Initial laboratory workup was remarkable for a positive polymerase chain reaction COVID-19 test, D-dimer 6590 ng/ml, and CT imaging of the brain, chest, abdomen, and pelvis that showed pulmonary opacities consistent with known infection, and no acute intracranial, aortic, or other abnormality.

Approximately 12 h after the initial ED presentation, the patient reported worsening paresthesias and weakness. Repeat exam revealed complete loss of sensation in her lower extremities and severely limited range of motion in her hips, knees, and ankle joints. She had positive proprioception but diminished reflexes bilaterally in her lower

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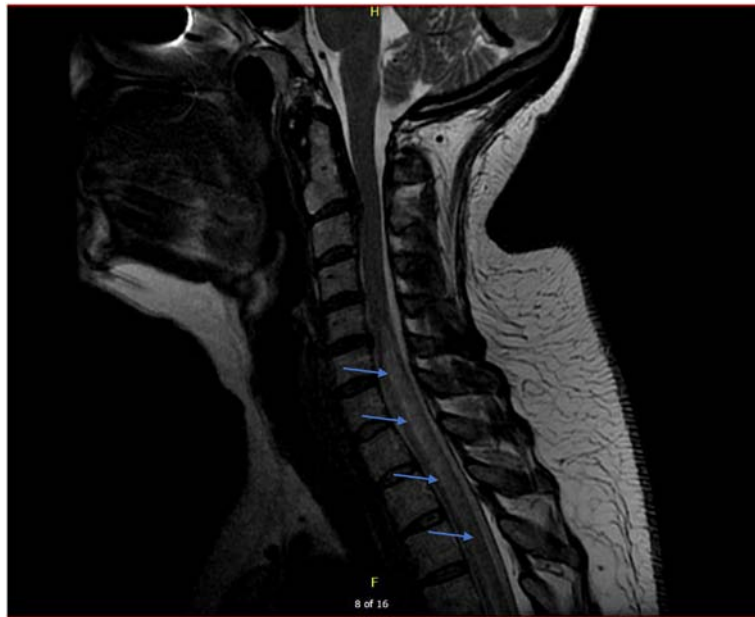


Fig. 1. SAG T2 MRI showing cervical spinal cord edema.

extremities. She requested a foley catheter because she could not initiate urination. Magnetic resonance imaging (MRI) of the spine revealed diffusely abnormal signal and central cord edema of the majority of the spinal cord extending from approximately the C5-C6 level through the T11-T12 level. There was cord expansion as well as ill-defined associated enhancement. (See Figs. 1 and 2.) The radiologist reported that given the patient's recent history of COVID-19 infection, the findings are most consistent with an extensive viral transverse myelitis.

The patient was initially admitted to the general medical floor, however, her weakness rapidly progressed to her upper chest and distal upper extremities, causing her to develop shallow breathing and posterior neck pain. She was transferred to the neurological intensive care

unit for concern for airway compromise and was intubated shortly after. Initial lumbar puncture was notable for elevated glucose (157 mg/dl), protein (201 mg/dl), nucleated cells (949 cells/uL), and myelin basic protein (>112.00 ng/ml) without evidence of bacterial, viral, or fungal infiltration. The patient was treated with a steroid regimen for 24 days, four rounds of plasmapheresis, remdesivir, and antibiotics. Patient was deemed not a candidate for extubation, so she underwent tracheostomy and percutaneous endoscopic gastrostomy tube placement for prolonged ventilatory and nutrition needs. Throughout the remainder of her hospital course, she did not have any improvement in neurologic status and was transferred to a long-term care and rehabilitation facility for quadriplegia.



Fig. 2. SAG STIR fast IR MRI showing thoracic spinal cord edema.

3. Discussion

Transverse myelitis (TM) is an uncommon neurological syndrome characterized by acute or subacute spinal cord dysfunction that can lead to paresthesias, sensory and autonomic impairment, and even paralysis [3]. It is usually in a predictable distribution below a specific spinal root [3]. The annual incidence of TM ranges from about 1.34 to 4.60 cases per million people [3]. TM incidence is typically bimodal, peaking in the second and fourth decades of life with approximately half of patients having a preceding infection [3]. Etiologies are often unclear, as potential causes include infection, neoplastic, drug or toxin induced, autoimmune, and acquired [3]. Diagnosis is often made by MRI to look specifically for surrounding spinal cord abnormalities. Common treatments include a steroid regimen and plasmapheresis, while keeping in mind to avoid the offending agent if one is identified [3].

COVID-19 most commonly presents with upper respiratory or pulmonary manifestations [2]. However, it has rarely displayed some degree of neurologic complications [4–7]. While the mechanisms of neurologic complications are vastly unknown, there are a few reports in the literature of transverse myelitis and other neurologic complications following all severities of COVID-19 infections. Most patients appear to completely recover neurologically [4–7]. However, our patient remained quadriplegic following her hospital course.

It is important to include transverse myelitis on the differential diagnosis for COVID-19 infected patients presenting with neurologic symptoms. Based on prior case reports and available literature, neurologic complications typically present 10 days post initial symptom onset of COVID-19 infection, however, complications can be seen even months later. Steroid therapy and plasmapheresis are the mainstays of treatment for transverse myelitis with resolution of neurologic symptoms in the vast majority of patients [8]. This case is unique in that the patients symptoms had no improvement with standard treatment and she remains a complete quadriplegic.

Prior presentations

None.

Funding sources/disclosures

None.

CRediT authorship contribution statement

Spencer Prete: Writing – review & editing, Supervision, Conceptualization. **Joseph McShannic:** Writing - original draft, Writing - review & editing. **Baruch S. Fertel:** Writing – review & editing, Visualization. **Erin L. Simon:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology.

Declaration of Competing Interest

The authors have no conflicts of interest to disclose.

References

- [1] World Health Organization. WHO Coronavirus (COVID-19) dashboard. World Health Organization; January 26, 2022. Retrieved from. <https://covid19.who.int/>.
- [2] Fumery T, Baudar C, Ossemann M, London F. Longitudinally extensive transverse myelitis following acute COVID-19 infection. *Mult Scler Relat Disord.* 2021;48:102723. <https://doi.org/10.1016/j.msard.2020.102723>.
- [3] Arslan D, Acar-Ozen P, Gocmen R, Elibol B, Karabudak R, Tuncer A. Post-COVID-19 longitudinally extensive transverse myelitis: is it a new entity? *Neurol Sci.* November 24, 2021. <https://doi.org/10.1007/s10072-021-05640-1>. Published online.
- [4] Kara S, Candelore T, Youssef P, Nedd K. Evidence of post-COVID-19 transverse myelitis demyelination. *Cureus.* October 27, 2021. <https://doi.org/10.7759/cureus.19087>. Published online.
- [5] Portela-Sánchez S, Sánchez-Soblechero A, Melgarejo Ojalora PJ, et al. Neurological complications of COVID-19 in hospitalized patients: the registry of a neurology department in the first wave of the pandemic. *Eur J Neurol.* 2021;28(10):3339–47. <https://doi.org/10.1111/ene.14748>.
- [6] Beh SC, Greenberg BM, Frohman T, Frohman EM. Transverse myelitis. *Neurol Clin.* 2013;31(1):79–138. <https://doi.org/10.1016/j.ncl.2012.09.008>.
- [7] Roy D, Ghosh R, Dubey S, Dubey MJ, Benito-León J, Kanti Ray B. Neurological and neuropsychiatric impacts of COVID-19 pandemic. *Can J Neurol Sci.* 2021;48(1):9–24. <https://doi.org/10.1017/cjn.2020.173>.
- [8] Schulte EC, Hauer L, Kunz AB, Sellner J. Systematic review of cases of acute myelitis in individuals with COVID-19. *Eur J Neurol.* 2021;28(10):3230–44. <https://doi.org/10.1111/ene.14952>.