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CASE REPORT

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Longitudinally extensive transverse myelitis (LETM) secondary to SARS-CoV-2 infection: A recent reality in spinal cord injury rehabilitation

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Abstract

Transverse myelitis can be a complication of SARS-CoV-2 infection. We report the case of a transverse myelitis related to SARS-CoV-2 infection. Beyond the disease itself, neurological involvement affects functionality. In this situation, physical and rehabilitation medicine plays a crucial role in managing patient rehabilitation.

KEYWORDS

rehabilitation, SARS-CoV2, spinal cord injury, transverse myelitis

1 | INTRODUCTION

Since its appearance and spread to become the most recent pandemic in human history, SARS-CoV-2 infection (COVID-19) has claimed more than 5.6 million lives worldwide. This infection primarily affects the respiratory system.[1,4] However, COVID-19 seems to be associated with a broad spectrum of non-respiratory symptoms and diseases, including neurological manifestations.[1] It is essential to recognize neurological involvement in COVID-19, some of which require urgent intervention.[1] Transverse myelitis (TM) is one of the possible disorders associated with COVID-19, with few cases described in the literature.[1–4] However, like other causes of spinal cord injury (SCI), management of complications must not be disregarded. Most case reports do not include the rehabilitation and the reality of the process after hospital discharge.

We present a case report and rehabilitation of a longitudinally extensive transverse myelitis (LETM) with the identification of SARS-CoV-2 in the cerebrospinal fluid.

2 | CASE REPORT

An 84-year-old male patient was admitted to the emergency department (ED) with fever, without any other symptoms. He had a previous history of hypertension, benign prostate hyperplasia, and a partial gastrectomy due to gastric ulcer perforation, 40 years before. Chest X-rays were normal, and laboratory tests showed a slightly raised C-reactive protein (CRP), and no other significant alterations, except for a positive nasopharyngeal swab for RT-PCR SARS-CoV-2. As the patient had no alarming clinical signs, he was discharged.

Two weeks after discharge, the patient returned to the ED, complaining of urinary retention, lower limb weakness, and hypoesthesia. Neurological examination revealed no cognitive impairment, isochoric, normoreactive pupils, preserved cranial nerve function, absent meningeal signs, and normal upper limb strength. Lower limb examination showed predominant right-side paraparesis. Maximum capable strength was present in left foot dorsiflexion (grade 3 of the Medical Research Council scale). Lower limb hyperreflexia was present, and Babinski sign was present bilaterally. Initial sensory testing revealed hypoesthesia from the left T5 and right T8 metameric levels. Laboratory tests showed lymphopenia, increased CRP levels, ferritin, and lactate dehydrogenase. A new throat swab showed a positive SARS-CoV-2 PCR, and blood serology revealed both IgM and IgG anti-SARS-CoV-2 antibodies. A broad panel of other infectious and immunological tests was performed, such as MOG-IgG and AQP4-IgG, which were all negative. A lumbar puncture (LP) showed slightly elevated leucocytes and proteins. The bacterial cultures and the polymerase-chain-reaction (PCR) of the cerebrospinal fluid (CSF) for the detection of virus and bacteria were negative except for the detection of SARS-CoV-2 RNA.

Chest CT revealed a patchy ground-glass consolidation in the lung lower lobes. Brain magnetic resonance imaging (MRI) did not show any alteration. However, spine MRI exposed an extensive increased T2 signal that involved central gray matter and dorsal columns from C1 to T10 compatible with longitudinally extensive transverse myelitis (LETM) (Figures 1 and 2). Electromyography (EMG) showed no neurogenic alterations.

The patient was admitted and started high-dose corticosteroid and plasma exchange (PLEX) treatment. A second spine MRI carried 16 days after admission displayed marked attenuation of the initial lesion (Figures 3 and 4). Throughout hospitalization, the patient remained without any respiratory symptoms.

The first observation by a physiatrist occurred 6 days after admission. The motor, sensory impairment, and the SCI severity were evaluated using the American Spinal Injury Association Impairment Scale (AIS). The sensory level determined for pinprick (PP) and light touch (LT) was T4 and T8 for the left and right sides, respectively. The same motor levels were determined for both sides. For the neuro-urologic examination, the patient had no deep anal pressure (DAP), but voluntary anal contraction (VAC) was present. Based on the clinical findings, the SCI was classified as an AIS-D T4 lesion. Functional

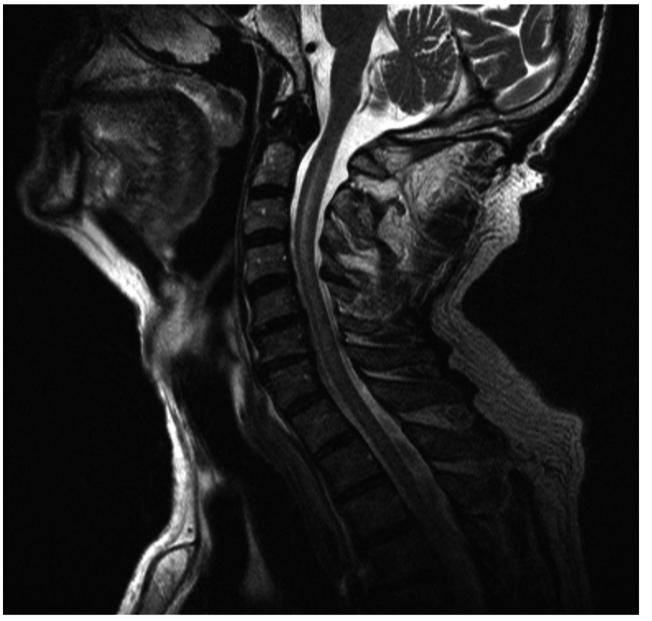

FIGURE 1 Cervical Spine MRI at admission showing increased T2 signal. compatible with longitudinally extensive transverse myelitis (LETM)

evaluation was also conducted. The patient had a class 0 on the New Functional Ambulation Classification (nFAC) scale as gait was impossible. The patient scored a total of 66 out of 126 on the Functional Independence Measure (FIM), in which 31 and 35 were in the motor and cognitive subscales, respectively. The score for Spinal Cord Independence Measure III (SCIM-III) scale was a total of 19 out of 100 points, with 4, 10, and 5 points in self-care, respiration and sphincter management, and mobility subscales, respectively.

The patient started a ward rehabilitation program comprised of daily respiratory kinesitherapy, early joint mobilization, and muscle strengthening.

The patient was discharged 24 days after admission to a rehabilitation center, with cure criteria for COVID-19. Functional scales at hospital discharge showed improvement, with a FIM score of 82 and a SCIM score of 40.

The patient remained hospitalized for four months, where he completed a comprehensive rehabilitation program adapted to his clinical condition, accompanied by a multidisciplinary team. The main objectives defined were recovery of motor, sensory, and gait capability, bladder and sphincter capacity determination, spasticity management, and education in compensation strategies for ADLs.

Overall, the patient had good evolution of the neuromotor condition, with progressive gain in the global muscle strength and balance. Initially, the rehabilitation program included core strengthening and sitting/standing training. Fourteen days after admission, the patient

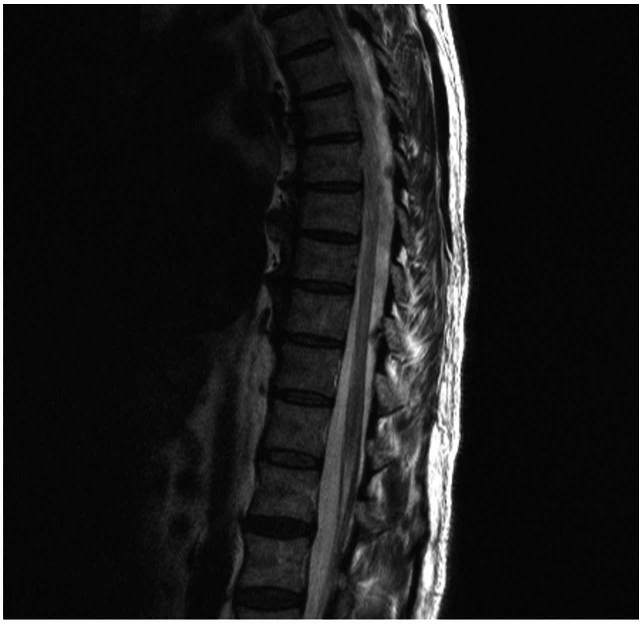

FIGURE 2 Thoracic Spine MRI at admission showing increased T2 signal. compatible with longitudinally extensive transverse myelitis (LETM)

FIGURE 4 Thoracic Spine MRI at day 16 after corticosteroid and plasma exchange treatment with attenuation of the initial lesion

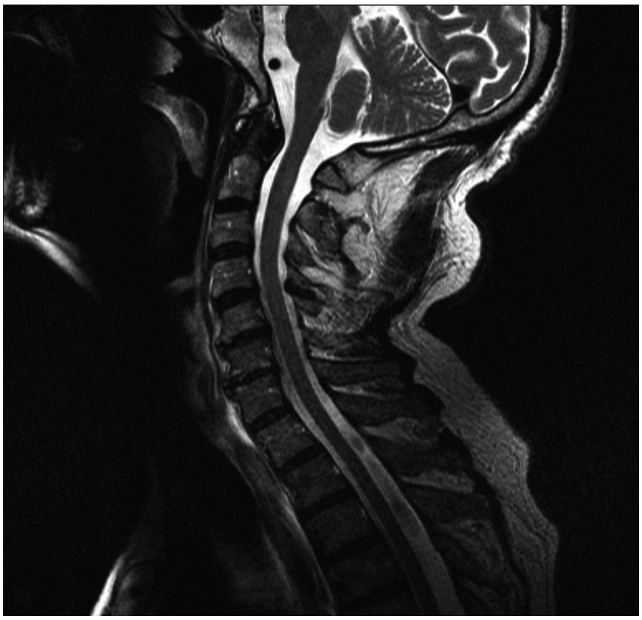

FIGURE 3 Cervical Spine MRI at day 16 after corticosteroid and plasma exchange treatment with attenuation of the initial lesion

initiated gait training on a dynamic walker. In the first month, gait was possible with crutches and supervision only. At two months, he was able to walk approximately 70m with crutches, and by the third month, he did not require a wheelchair for ambulation. At discharge, the patient acquired an autonomous gait using only a pole.

Concerning urinary retention, the patient was submitted to a urodynamic study (UDS) which revealed detrusor sphincter dyssynergia (DSD) and decreased detrusor contraction. An attempt was made to institute a spontaneous urination regime and measurement of residual volumes. However, as the patient presented very low outputs, it was necessary to execute a schedule of self-intermittent catheterizations. Intestinal transit regulation was achieved through medication, with no evidence of involuntary fecal loss.

The patient gained modified autonomy in all ADLs including the ability to put on socks and shoes.

Functional scales scores showed improvement, with a progressive increase in FIM, SCIM, and nFAC scales. The final scores in the different functional scales applied at discharge were a total FIM of 116 out of 126 (81 and 35 points in motor and cognitive subscales, respectively), a total SCIM-III score of 77 out of 100 points (17, 30, and 30 points in self-care, respiration and sphincter management, and mobility subscales, respectively), and a nFAC class of 7/8.

3 | DISCUSSION

Myelitis refers to an inflammation process of the spinal cord. The term transverse myelitis has become synonymous with an immune-mediated process. However, several other causes of myelitis include infectious, immune, or other disorders.[2,3] In our case, these causes were discarded.[3] Viruses are a possible cause of TM.[2] There is a substantial amount of evidence showing that viruses can invade the CNS and provoke neurological symptoms, including coronaviruses.[1,2,5] Although coronaviruses are known to cause mainly respiratory and enteric infections, these can be potential triggers for para or post-infection TM.[1,6,7] Potential neuroinvasive pathways have been hypothesized.[5] SARS-CoV-2 is predominantly transmitted by inhalation of respiratory droplets. It enters human cells through angiotensin-converting enzyme 2 (ACE2) receptors present in mucous membranes. After local invasion, the virus can reach the CNS in various ways.[5] The first is based on the neurotropic properties of SARS-CoV-2, and direct CNS viral invasion, via blood circulation, nasal epithelium, or peripheral nerves through the ACE2 receptors. Notably, ACE2 receptors are also expressed on the membrane of the spinal cord. Another mechanism is an immunological reaction to SARS-CoV-2, resulting in a cytokine storm, compromising the blood-brain barrier (BBB) and allowing damage to myelin.[1,5] According to recent systematic reviews, SARS-CoV-2 was present in CSF in six other COVID-19 associated TM cases.[8,9] Although SARS-CoV-2 can rarely be present in the CNS, a systematic review concluded that CSF positive SARS-CoV-2 PCR does not definitively indicate neuroinvasion, and still warrants more discussion.[9,10]

As far as treatment is concerned, corticosteroids and PLEX are the most effective therapy available in the acute stage of TM before referral to rehabilitation.[3] However, the neurological outcome in patients with TM cannot be predicted based on MRI findings. There is a significant disparity in the imaging level and clinical presentation. In the acute and sub-acute phase of illness, patients are likely to have low functional ability.[11]

Another essential issue to address, and often disregarded in case reports, is the rehabilitation aspect after any disorder. Restoration of functionality and participation should be the ultimate goal in healthcare, particularly in patients with neurological complications of SARS-CoV-2, such as TM. Management in rehabilitation institutions is essential, especially in SCI patients. The rehabilitation approach is not new and depends on the action of a multidisciplinary team. The main objectives of TM rehabilitation is to improve the patient's functional ability in performing activities of daily living through improving range of motion, strength, effective compensatory strategies, and relieving pain.[11,12] In order to accomplish these objectives, some outcome measures are needed. In our case, we applied a range of functional scales such as FIM, SCIM, and nFAC. FIM scale is often considered the gold-standard for assessing basic ADLs. It consists of 18 items divided in two subscales: a motor and a cognitive subscale. Each item is scored on a 7-point ordinal scale, ranging from 1 (total dependence) to a score of 7 (total independence) and with a minimum of 18 points, and a maximum score of 126 points. Higher scores reflect fewer care hours required upon discharge. The FIM is not SCI specific. It has limitations in sensitivity to component abilities within tasks for people with SCI. The FIM does not also measure the social, psychological, or vocational impact of disability experienced by those living with SCI.[13] The SCIM-III is a disability scale developed to address specifically the ability of SCI patients to perform basic activities of daily living independently. It consists of 19 items accessed in 3 areas: self-care, respiration, and sphincter management, and mobility. Scores are derived by adding up the items producing a total score (0–100) and/or subscale scores (self-care: 0–20; respiration and sphincter management: 0–40; mobility 0–40). Item response categories vary from item to item, ranging from 0–2 to 0–15. The SCIM is one of the most frequently used scales within the SCI population and has high clinical relevance for the rehabilitation of individuals with either traumatic or non-traumatic and type of SCI.[14] Evaluation of ambulation has several classification systems. The nFAC is a 9-point Likert Scale (0–8) that is used to classify a patient's walking capacity. Gait is divided into categories ranging from total incapacity (Class 0) to independent ambulation (Class 8).[15]

Bladder and bowel dysfunction is common in neurologic diseases, particularly SCI, and has a significant impact on quality of life.[16]

A neurogenic bladder can have different patterns of dysfunction. This includes altered bladder sensation, overactivity, underactivity of the detrusor muscle, and/or internal and external sphincters, and absence of coordination between the detrusor and sphincters during voiding. This process is also referred as detrusor sphincter dyssynergia (DSD). A spastic bladder usually occurs with a SCI above the conus medullaris, while an areflexic bladder usually occurs in injuries at and below T12-L1, including conus medullaris and cauda equina injuries. The spastic bladder is often referred as an upper motor neuron (UMN) bladder, while the flaccid bladder is referred to as a lower motor neuron (LMN) bladder.[17,18] Detrusor overactivity and DSD can result in high pressures within the lower urinary tract, which may subsequently affect the upper urinary tract, resulting in vesicoureteric reflux, hydronephrosis, and, in some instances, renal impairment and end-stage renal disease.[16,17] In addition, persistent detrusor overactivity with or without DSD can contribute to maladaptive trabeculation and hypertrophy of the bladder wall, as well as reduced bladder volumes.[17] Management of neurogenic bladder dysfunction requires a multidisciplinary approach involving neurologists, urologists and physical medicine, and rehabilitation specialists. Urodynamic studies remain an essential component of initial urologic evaluation after SCI. Urodynamic studies are important to assess bladder and sphincter function regardless of the type of bladder management.[18–20] Non-invasive evaluation is mandatory before invasive urodynamics is planned.[18] The functional goal of bladder management following SCI is to tailor a bladder emptying program that is specific to the individual and compatible the patient lifestyle and activities of daily living. Medical goals include achieving regular bladder emptying and avoiding stasis, avoiding high filling, voiding pressures, and preventing and treating complications such as urinary tracts infections.[16,17] This can be achieved by a combination of different drugs and/or procedures, depending on the type of dysfunction.[16–18] In our case, as the patient had a voiding dysfunction, it was essential to implement a self-intermittent catheterizations regimen.

Neurogenic bowel management is also a crucial aspect to address these patients.[16] Bowel dysfunction affects most patients with a SCI. Disrupted autonomic control of the gastrointestinal tract is the primary cause for neurogenic bowel dysfunction, leading to delayed gastric emptying and poor colonic motility.[21] Following SCI, two patterns of bowel dysfunction can occur. UMN lesions increase colonic wall and anal tone. However, voluntary control of the external anal sphincter is lost or impaired, and the sphincter remains tight, promoting stool retention. LMN lesions result in slow stool propulsion and impaired reflex stool evacuation.[16,21] Management of neurogenic bowel dysfunction depends upon a rigorous routine of diet, rectal stimulants, laxatives, and physical interventions. Evidence to support these routines is lacking and involves trial and error measures.[21]

Generally, patients exhibit substantial improvement, especially with inpatient rehabilitation, where these functionality issues are addressed, as it happened in our case, with improvement in every functional scale applied.

4 | CONCLUSION

SARS-CoV-2 can be responsible for a broad range of neurological symptoms and diseases. Although TM is relatively uncommon within the spectrum of COVID-19, it causes a significant burden for patients and their families. Despite the absence of evidence of viral neuroinvasion, this possibility has not yet been excluded.

Functionality is the foundation of daily living. In this new pandemic era, physiatrists need to be aware of this new reality as the medical specialty that will be called upon to manage potential complications of COVID-19 survivors, including SCI.

AUTHOR CONTRIBUTIONS

João P. Fonseca involved in patient management, conception, manuscript design, manuscript writing, and corresponding author. Alexandra Coelho, Ana C. Lourenço, and César Pires involved in patient management and scientific revision of the manuscript. Paulo Margalho involved in patient management, supervising, and scientific revision of the manuscript. All authors read and approved the final version of the manuscript.

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CONFLICTS OF INTEREST

The authors have no conflict of interest to disclose.

DATA AVAILABILITY STATEMENT

The datasets used during the current case are available from the corresponding author on reasonable request.

CONSENT

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

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