We present a patient with ataxia and tremor in the context of COVID-19, an association not previously reported. More data from cases with similar characteristics are needed to establish a causal relationship between SARS-CoV-2 infection and these symptoms. In any case, our report contributes further evidence of the potential role of the virus in the development of neurological symptoms.

## References


1. Matías-Guiu J, Gomez-Pinedo U, Montero-Escribano P, Gomez-Iglesias P, Porta-Et essam J, Matias-Guiu JA. ¿Es esperable que haya cuadros neurológicos por la pandemia por SARS-CoV-2? Neurologia. 2020;35:170—5.
2. Nath A. Neurologic complications of coronavirus infections. Neurology. 2020;12:809—10.
3. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020;15:497—506.
4. Mao L, Jin H, Wang M, Hu Y, Chen S, He Q, et al. Neurologic Manifestations of Hospitalized Patients With Coronavirus Disease 2019 in Wuhan, China. JAMA Neurol. 2020:e201127, http://dx.doi.org/10.1001/jamaneurol.2020.1127.
5. Zhao H, Shen D, Zhou H, Liu J, Chen S. Guillain-Barré syndrome associated with SARS-CoV-2 infection: causality or coincidence? Lancet Neurol. 2020;19:383—4.
6. Gutiérrez-Ortiz C, Méndez A, Rodrigo-Rey S, San Pedro Murillo E, Bermejo-Guerrero L, Gordo-Mañas R, et al. Miller Fisher syndrome and polyneuritis cranialis in COVID-19. Neurology. 2020;10, http://dx.doi.org/10.1212/WNL.0000000000009619.
7. Rábano-Suárez P, Bermejo-Guerrero L, Méndez-Guerrero A, Parra-Serrano J, Toledo-Alfocea D, Sánchez-Tejerina D, et al. Generalized myoclonus in COVID-19. Neurology. 2020;40:332—43.
8. Overby P, Kapklein M, Jacobson RI. Acute ataxia in children. Pediatr Rev. 2019;40:332—43.



A.M. Diezma-Martín[a,*], M.I. Morales-Casado[a], N. García Alvarado[a], A. Vadillo Bermejo[a], N. López-Ariztegui[a], M.A. Sepúlveda Berrocal[b]

[a] *Servicio de Neurología, Hospital Virgen de la Salud, Toledo, Spain*
[b] *Servicio de Medicina Interna, Hospital Virgen de la Salud, Toledo, Spain*

* Corresponding author.
*E-mail address:* alba1794@gmail.com
(A.M. Diezma-Martín).


https://doi.org/10.1016/j.nrleng.2020.06.004
2173-5808/


# The future of neurorehabilitation after the SARS-CoV-2 pandemic☆

## Futuro de la neurorrehabilitación tras la pandemia por el SARS-CoV-2

*Dear Editor:*

The novel coronavirus SARS-CoV-2, causing coronavirus disease 2019 (COVID-19), emerged in the Chinese province of Hubei in December 2019. The epidemic outbreak in China rapidly spread over a period of months into the current pandemic, which has changed the lives of the world's population.[1]

Like other respiratory viruses, SARS-CoV-2 initially affects the respiratory system. Among other reasons, its high morbidity and mortality rates are explained by the exaggerated inflammatory response triggered in many patients, as it is a novel pathological agent for immune systems.

Little is known about the disease today, but the unprecedented efforts made in scientific research and publishing have enabled us to expand our knowledge of the condition over the past 3 months. However, although it is still too soon to know the long-term consequences, we already know that the disease affects many systems.[1] While the cardiovascular system was one of the first systems to be studied, the neurological system is not one of the least affected.[2]

Considerable prevalence of neurological complications has been reported (45% to 48%, depending on the methods used, in the few studies published to date). Complications affect both the central nervous system (confusional syndromes, stroke, encephalopathies, encephalitis, secondary epilepsy, etc) and the peripheral nervous system (critical illness polyneuropathy, Guillain-Barré syndrome, cranial neuropathies, etc.), with associated muscular disease (critical illness myopathy).[2–5] Neurological sequelae are not limited to the functional level (loss of ventilatory/pulmonary capacity, generalised weakness and postural problems, secondary pain) but also include dysphagia, dysexecutive syndrome, apraxia, cognitive impairment, and such psychiatric disorders as depression, anxiety, and post-traumatic stress disorder, among others.[6]

As with other respiratory viruses, several hypotheses are emerging around the pathway by which it enters the central nervous system. It may enter through a trans-synaptic pathway involving the vagus nerve, which innervates the lower respiratory tracts, through the nasal epithelium and olfactory nerve; and/or through the haematogenous pathway, crossing the blood-brain barrier. Neurological involvement is likely to be caused by 2 mechanisms: hypoxic brain lesions and immune-mediated damage caused by the cytokine storm.[2]

☆ Please cite this article as: Juárez-Belaúnde A, Colomer Font C, Laxe S, Ríos-Lago M, Ferri Campos J. Futuro de la neurorrehabilitación tras la pandemia por el SARS-CoV-2. Neurología. 2020;35:410—411.

Furthermore, the virus usually has more severe effects in vulnerable populations and patients with multiple morbidities. It is now known that the typical cardiovascular risk factors in patients with acquired brain damage are also risk factors for complications of SARS-CoV-2 infection, and therefore may lead to admission to intensive care units (ICU), with high mortality rates.[6,7] Prolonged ICU stays lead to new comorbidities that significantly affect patients' functional and cognitive capacities. We must also consider mood and behavioural aspects associated with the stress caused.[6,8]

A percentage of patients attended in ICUs and with prolonged stays in hospitalisation wards present sequelae that require specialised rehabilitation therapy. Many also initially need to be transferred as inpatients to neurorehabilitation centres to recover from moderate to severe sequelae, with specific physiotherapy, occupational therapy, speech therapy, and neuropsychological care.[1,9]

Finally, despite a reduction in the number of strokes and other acquired brain injuries attended at emergency departments and acute care hospitals, thought to be explained by fear of contracting the virus at hospital (among other reasons), the prevalence of these pathologies has not changed over time; a new increase in the incidence of these disorders and the demand for neurorehabilitation therapy is expected as soon as the epidemiological situation resolves.[7,10] Therefore, specialised neurorehabilitation units will need to adapt their facilities and resources to enable better management both of patients with sequelae after SARS-CoV-2 infection and their usual patients; and to make use of new tools, in which we have specialised faster than expected. These tools, which include telemedicine for consultations and follow-up (teleconsultations), subsequent outpatient rehabilitation therapy, and the use of specific software (telerehabilitation), also enable adequate communication with the families of hospitalised patients while observing safety measures and avoiding unnecessary visits. We are also able to provide emotional support to patients and to ensure appropriate adaptation of homes and preparation of family members by teleconference prior to discharge.[4,9,11–13]

In short, like in many other areas of social care, SARS-CoV-2 has shown the resilience of neurorehabilitation professionals. Furthermore, with regard to involvement of the nervous system in particular and the possible medium- and long-term consequences, this area of healthcare has become fundamental in the recovery of the affected population.

## References


1. Sheehy LM. Considerations for postacute rehabilitation for survivors of COVID-19. JMIR Public Health Surveill. 2020;6:e19462.
2. Ahmad I, Azam F. Neurological manifestations and complications of COVID-19: a literature review. J Clin Neurosci. 2020, http://dx.doi.org/10.1016/j.jocn.2020.05.017.
3. Mao L, Wang M, Chen S, He Q, Chang J. Neurological manifestations of hospitalized patients with COVID-19 in Wuhan, China: a retrospective case series study. JAMA Neurol. 2020, http://dx.doi.org/10.1001/jamaneurol.2020.1127.
4. Matías-Guiu J, Porta-Etessam J, Lopez-Valdés E, García-Morales I, Guerrero-solá A, Matías-Guiu JA. La gestión de la asistencia neurológica en tiempos de la pandemia de COVID-19. Neurología. 2020;35:233—7, http://dx.doi.org/10.1016/j.nrl.2020.04.001.
5. Avindra N. Neurologic complications of coronavirus infections. Neurology. 2020;94:1—2.
6. Carda S, Invernizzi M, Bavikatte G, Bensmail D, Biancha F, Deltombe T, et al. The role of physical and rehabilitation medicine in the COVID-19 pandemic: the clinician's view. Ann Phys Rehabil Med. 2020, http://dx.doi.org/10.1016/j.rehab.2020.04.001.
7. Mamo J, Feroz B, Mahmood S. Covid-19: protecting patients in hospital for neurorehabilitation and their therapists. BMJ. 2020, http://dx.doi.org/10.1136/bmj.m1630.
8. Laxe S, Page FS, Chaler JCM, Fraguas J, Gómez LG, Llavona A, et al. La rehabilitación en los tiempos del COVID-19. Rehabilitación. 2020, http://dx.doi.org/10.1016/j.rh.2020.04.001.
9. Leocani L, Diserens K, Moccia M, Caltagirone C. Disability through COVID-19 pandemic: neurorehabilitation cannot wait. Eur J Neurol. 2020, http://dx.doi.org/10.1111/ENE.14320.
10. Rosenbaum L. The untold toll—the pandemic's effects on patients without Covid-19. N Engl J Med. 2020, http://dx.doi.org/10.1056/NEJMms2009984.
11. Hatcher-martin JM, Adams JL, Anderson ER, Bove R. Telemedicine in neurology. Telemedicine Work Group of the American Academy of Neurology update. Neurology. 2020;94:30—8.
12. Murieta ES, Supervia M. Covid19 y cronicidad. Una oportunidad de reinventar los servicios de medicina fisica y rehabilitacion. Rehabilitacion. 2020, http://dx.doi.org/10.1016/j.rh.2020.05.002.
13. De Sire A, Andrenelli E, Negrini F, Negrini S, Ceravolo MG. Systematic rapid living review on rehabilitation needs due to COVID-19: update to April 30th 2020. Eur J Phys Rehabil Med. 2020, http://dx.doi.org/10.23736/S1973-9087.20.06378-9.



A. Juárez-Belaúnde[a,f,*], C. Colomer Font[b,f], S. Laxe[c,f], M. Ríos-Lago[d,e,f], J. Ferri Campos[b,f]

[a] *Unidad Avanzada de Neurorrehabilitación, Hospital Los Madroños, Madrid, Spain*
[b] *NueroRHB, Servicio de Neurorehabilitación, Hospitales Vithas, Valencia, Spain*
[c] *Servicio de Medicina Física y de Rehabilitación, Hospital Clinic de Barcelona, Barcelona, Spain*
[d] *Unidad de Daño Cerebral, Hospital Beata María Ana, Madrid, Spain*
[e] *Departamento de Psicología Básica II (UNED), Madrid, Spain*
[f] *Junta Directiva Sociedad Española de Neurorrehabilitación, Spain*

* Corresponding author.
*E-mail address:* alanluisjb@hotmail.com
(A. Juárez-Belaúnde).


https://doi.org/10.1016/j.nrleng.2020.06.003
2173-5808/