Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Letter to the Editor

Neurological features of COVID-19 and epilepsy: Could neuromuscular assessment be a physical and functional marker?

To the Editor,

There is growing interest in the effects of coronavirus disease 2019 (COVID-19) on the brain and the neurological consequences and features. Kuroda [1] recently published an interesting article in Epilepsy & Behavior and titled "*Epilepsy and COVID-19: Associations and important considerations*". In this article, the author highlighted the importance of researchers looking for possible interactions of COVID-19 and epilepsy since the infection could also have harmful effects on the brain. For example, people with epilepsy infected with COVID-19 may have fever, which may possibly trigger seizures [1]. The purpose of our letter is to expand the vision and suggest neuromuscular markers and muscle strength evaluation for the monitoring and prognosis of patients with epilepsy who have acquired COVID-19 infection.

Previous studies showed that survivors of acute respiratory diseases might present functional disability for one year after discharge [2], with muscle wasting and weakness being most frequent extrapulmonary conditions [3]. The cardinal clinical manifestations of COVID-19 include limb muscle weakness, muscle atrophy, and reduced or missing deep tendon reflexes [4]. Moreover, admission at intensive care units is associated with impaired physical function and poor quality of life for up to one year after discharge [5]. In this regard, physical function is heavily affected by critical illness and is less likely to recover to normal values [6]. It is important to highlight that pulmonary diseases are commonly associated with loss of muscle mass and function [7]. The analysis of previous outbreaks of severe acute respiratory syndrome (SARS) revealed that 6–20% of the patients showed mild or moderate restrictive lung function consistent with muscle weakness (and low functional capacity) 6–8 weeks after hospital discharge [8]. Moreover, exercise capacity and health status were remarkably lower in survivors from SARS than those of a normal population [9]. Osthoff et al. [10] showed that, in people with pulmonary disease, low muscle strength is associated with physical inactivity and, consequently, low functional capacity to perform the tasks of daily living. This is an independent predictor of morbidity and mortality independent of the degree of respiratory limitation [11].

Regarding the current pandemic, Solomon et al. [12] showed that patients with COVID-19 can present acute hypoxic brain injury. Therefore, it is reasonable to assume that these hypoxic injuries can cause neuromuscular consequences in COVID-19 patients, depending on the severity of the condition. Helms et al. [13] observed that of the 45 COVID-19 patients, who had been part of their study, 33% presented a dysexecutive syndrome and movement disorders that is, inattention, disorientation, and poorly organized movements in response to command. Siebenmann and Rasmussen [14] pointed out that reduced systemic oxygen availability (also observed in patients with COVID-19) could promote central fatigue and myalgia. Silva et al. [15] showed that mechanically ventilated patients developed neuromuscular electrophysiological disorders. Thus, it is possible to assume that all these neurological consequences of COVID-19 could be more devastating in patients with epilepsy. Nikbakht et al. [16] observed that the epilepsy associated with COVID-19 infection could be caused by the entry and high levels of pro-inflammatory cytokines in the brain. Proinflammatory cytokines could break through the blood–brain barrier, increase glutamate and aspartate and reduce gamma-aminobutyric acid levels, which impair the functioning of ion channels and consequently cause epileptic seizures. Carod-Artal [17] states that depending on the severity of the condition, the virus could cause neurological disorders such as headache, dizziness, and myalgia and even cases of encephalopathy, encephalitis, stroke, and epileptic seizures. Supposedly, these factors associated with prolonged muscle disuse and physical inactivity, and when two clinical conditions (COVID-19 and Epilepsy) are combined, could affect negatively physical fitness and functional capacity and, therefore, physical rehabilitation and monitoring are essential [18].

From the above, it is plausible to assume that neuromuscular and muscle strength performances are altered negatively in patients who were affected by COVID-19 and those who also have epilepsy. Thus, neuromuscular and muscle strength assessment [19,20] is relevant in the follow-up and rehabilitation/monitoring/training of patients who acquired COVID-19 and have epilepsy, and parameters provided by neuromuscular assessment, such as isokinetic dynamometer and handgrip strength, could be used as a physical and functional marker.

Conflict of Interest

Authors have no competing interests to declare.

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References

[1] Kuroda N. Epilepsy and COVID-19: Associations and important considerations. Epilepsy Behav 2020;108:107122.
[2] Tansey CM, Louie M, Loeb M, Gold WL, Muller MP, de Jager J, et al. One-year outcomes and health care utilization in survivors of severe acute respiratory syndrome. Arch Intern Med 2007;167:1312–20.

https://doi.org/10.1016/j.yebeh.2020.107648

[3] Herridge MS, Cheung AM, Tansey CM, Matte-Martyn A, Diaz-Granados N, Al-Saidi F, et al. One-year outcomes in survivors of the acute respiratory distress syndrome. N Engl J Med 2003;348:683–93.
[4] Li Z, Cai Y, Zhang Q, Zhang P, Sun R, Jiang H, et al. Intensive care unit acquired weakness: A protocol for an overview of systematic reviews and meta-analysis. Medicine (Baltimore) 2020;99:e21926.
[5] Jackson JC, Ely EW, Morey MC, Anderson VM, Denne LB, Clune J, et al. Cognitive and physical rehabilitation of intensive care unit survivors: results of the RETURN randomized controlled pilot investigation. Crit Care Med 2012;40:1088–97.
[6] Gerth AMJ, Hatch RA, Young JD, Watkinson PJ. Changes in health-related quality of life after discharge from an intensive care unit: a systematic review. Anaesthesia 2019;74:100–8.
[7] Bone AE, Hepgul N, Kon S, Maddocks M. Sarcopenia and frailty in chronic respiratory disease: Lessons from gerontology. Chron Respir Dis 2017;14:85–99.
[8] Chan KS, Zheng JP, Mok YW, Li YM, Liu YN, Chu CM, et al. SARS: prognosis, outcome and sequelae. Respirology 2003;8(Suppl):S36–40.
[9] Hui DS, Wong KT, Ko FW, Tam LS, Chan DP, Woo J, et al. The 1-year impact of severe acute respiratory syndrome on pulmonary function, exercise capacity, and quality of life in a cohort of survivors. Chest 2005;128:2247–61.
[10] Osthoff AK, Taeymans J, Kool J, Marcar V, van Gestel AJ. Association between peripheral muscle strength and daily physical activity in patients with COPD: a systematic literature review and meta-analysis. J Cardiopulm Rehabil Prev 2013;33:351–9.
[11] Swallow EB, Reyes D, Hopkinson NS, Man WD, Porcher R, Cetti EJ, et al. Quadriceps strength predicts mortality in patients with moderate to severe chronic obstructive pulmonary disease. Thorax 2007;62:115–20.
[12] Solomon IH, Normandin E, Bhattacharyya S, Mukerji SS, Keller K, Ali AS, et al. Neuropathological features of Covid-19. N Engl J Med 2020. NEJMc2019373.
[13] Helms J, Kremer S, Merdji H, Clere-Jehl R, Schenck M, Kummerlen C, et al. Neurologic features in severe SARS-CoV-2 infection. N Engl J Med 2020;382:2268–70.
[14] Siebenmann C, Rasmussen P. Does cerebral hypoxia facilitate central fatigue? Exp Physiol 2016;101:1173–7.
[15] Silva PE, Maldaner V, Vieira L, Livino de Carvalho K, Gomes H, Melo P, et al. Neuromuscular electrophysiological disorders and muscle atrophy in mechanically-ventilated traumatic brain injury patients: New insights from a prospective observational study. J Crit Care 2018;44:87–94.
[16] Nikbakht F, Mohammadkhanizadeh A, Mohammadi E. How does the COVID-19 cause seizure and epilepsy in patients? The potential mechanisms. Mult Scler Relat Disord 2020;46:102535.
[17] Carod-Artal FJ. Neurological complications of coronavirus and COVID-19. Rev Neurol 2020;70:311–22.
[18] Barker-Davies RM, O'Sullivan O, Senaratne KPP, Baker P, Cranley M, Dharm-Datta S, et al. The Stanford Hall consensus statement for post-COVID-19 rehabilitation. Br J Sports Med 2020;54:949–59. https://doi.org/10.1136/bjsports-2020-102596.
[19] Christian RJ, Bishop DJ, Billaut F, Girard O. Peripheral fatigue is not critically regulated during maximal, intermittent, dynamic leg extensions. J Appl Physiol (1985) 2014;117:1063–73.
[20] Pontes SS, de Carvalho ALR, Almeida KO, Neves MP, Ribeiro Schindler IFS, Alves IGN, et al. Effects of isokinetic muscle strengthening on muscle strength, mobility, and gait in post-stroke patients: a systematic review and meta-analysis. Clin Rehabil 2019;33:381–94.

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