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Case Report

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Rehabilitation interventions in long COVID: a case report

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ABSTRACT. The repercussions of Long COVID demand specialised rehabilitation care. Interdisciplinary interventions in a 58-year-old patient were implemented to improve the clinical, motor and cognitive complaints associated with COVID-19. The rehabilitation team performed quantitative and qualitative evaluations in the initial phase and after 12 months of follow-up. The patient's neuropathic pain, ankle and foot muscle strength, gait pattern, general cognitive functioning, initiative, emotional expressiveness, processing speed, neuropsychiatric symptoms and quality of life improved. She demonstrated gains in metacognition and expanded the use of compensatory strategies, resuming her routine and professional activities, although still with signs of executive dysfunction. It is concluded that a rehabilitation program calibrated to the profile of the patient with Long COVID had positive effects on functionality and satisfaction with quality of life.

Keywords: Post-Acute COVID-19 Syndrome; Rehabilitation; Patient Care Team; Mononeuropathies; Cognitive Training.

Intervenções em reabilitação na COVID longa: relato de caso

RESUMO. As repercussões da COVID Longa demandam atendimentos especializados de reabilitação. Intervenções interdisciplinares em paciente de 58 anos foram implementadas com o objetivo de melhorar as queixas clínicas, motoras e cognitivas associadas à COVID-19. A equipe de reabilitação realizou avaliações quantiqualitativas na fase inicial e após 12 meses de acompanhamento. A paciente evoluiu com melhora da dor neuropática, da força muscular de tornozelo e pé, do padrão de marcha, do funcionamento cognitivo geral, da iniciativa, da expressividade emocional, da velocidade de processamento, dos sintomas neuropsiquiátricos e da qualidade de vida (domínios físico e psicológico). Demonstrou ganhos na metacognição e ampliou o uso de estratégias compensatórias, retomando suas atividades rotineiras e profissionais, embora ainda com indícios de disfunção executiva. Conclui-se que um programa de reabilitação calibrado ao perfil do paciente com COVID longa trouxe efeitos positivos na funcionalidade e satisfação com a qualidade de vida.

Palavras-chave: Síndrome Pós-COVID-19 Aguda; Reabilitação; Equipe de Assistência ao Paciente; Mononeuropatias; Treino Cognitivo.

INTRODUCTION

Infection with the SARS-CoV-2 virus can lead to persistent multisystem sequelae because it is associated with changes in the central nervous and musculoskeletal systems, which is a condition called Long COVID[1,2].

There are several reports of neurological sequelae associated with COVID-19. Brain disorders predominate, followed by peripheral (immune-mediated) neuropathies. The neurological manifestations occurred during the acute and postacute phases and presented different severities and outcomes of COVID-19. Acute ischaemic stroke was the most commonly reported disease, followed by Guillain Barré syndrome, cranial neuropathies, encephalopathy/meningitis, cerebral venous thrombosis, intracerebral haemorrhage, myelitis/myelopathy, parainfectious (autoimmune) encephalopathies, other peripheral neuropathies, posterior reversible encephalopathy, acute necrotising encephalopathy and seizures/epilepsy[3].

In addition, there are repercussions of the sequelae associated with COVID-19 on the general functioning and quality of life

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of the affected individual[1,2,4]. In the Sarah Network, the Post-COVID Rehabilitation Program encompasses the performance of the multidisciplinary team in the process of evaluation, intervention and follow-up of the affected person. Each professional specialty has a key role in the treatment program to resolve or minimise the complaints presented.

Psychology works with the main objective of cognitive and neuropsychological rehabilitation, including psychoeducation, training in specific functions, application of compensatory strategies and stimulation of global functioning[5].

Rehabilitation of neurological sequelae presented by patients with COVID-19 may include a specific program of physiotherapeutic exercises and functional training, in addition to the use of orthoses, regular practice of physical activities and management of neuropathic pain[6].

The present study aims to present the effect of multidisciplinary rehabilitation interventions in a patient with COVID-19 during 12 months of follow-up.

CASE REPORT

The patient SOC, 58 years old, female, born and residing in São Luís-MA, was married and a trader who completed high school.

Clinical history

In April 2020, she remained hospitalized for approximately two months in a general hospital, including eighteen days in the intensive care unit, requiring orotracheal intubation due to acute respiratory syndrome, with diagnoses of COVID-19. After infection, she developed distal paresis of the right lower limb, neuropathic pain, and cognitive changes such as forgetfulness, memory lapses, slowness in information processing and difficulty concentrating.

She reported a history of epilepsy beginning at age 24, with the last seizure more than 15 years ago, and she had been using Trileptal regularly since that time.

She also reported regular use of the following medications for the treatment of neuropathic pain: pregabalin 150 mg/day, duloxetine 60 mg/morning, and the rescue use of tramadol associated with caffeine.

The patient denied any previous neuropsychiatric disorder, smoking, alcohol consumption, systemic arterial hypertension, diabetes mellitus and/or other comorbidities.

Social and daily life history

Prior to COVID-19, she had worked for 20 years with her husband in their own auto parts trade, performing full-time financial management and customer service roles. She reported few moments of leisure, and that she performed household chores, used to drive, did not practice physical activities. After hospital discharge, she went home and required support from family members for general tasks. Professional activities were gradually resumed but with a feeling of insecurity and frustration with the way it worked.

On physical examination, the patient presented a deficit of muscle strength throughout the RLL, predominantly distal, in addition to painful hypoesthesia in the same limb, sparing only the anterior aspect of the thigh.

Magnetic resonance imaging of the brain (SWI sequence) on September 22, 2022, showed microhemorrhages in both cerebral hemispheres, predominantly distributed in the cortico-subcortical transition of the frontal, parietal, occipital and temporal lobes (Figure 1).

Participation in the rehabilitation program

Eleven months after the onset of COVID-19, she was admitted to the neurology outpatient clinic of the Post-COVID Program of the SARAH Neurorehabilitation Hospital – São Luís Unit. Her main complaint was "weakness in the right leg" with a diagnostic of right sciatic mononeuropathy. She was referred for outpatient follow-up with internal medicine and physical therapy and, further on, with psychology and physical education.

The following month, she was evaluated at the physical therapy outpatient clinic. At the time, she walked without any mobility aid and complained of changes in strength and pain in the right lower limb, which restricted longer trips, such as shopping.

On physical examination, muscle strength was almost absent in the right ankle and foot (MRC 1/5 according to the Medical Research Council Scale[7]) and gait with right claudication (foot drop). A flexible right ankle-foot orthosis was introduced, and weekly follow-up was initiated for a period of 4 months, with exercises

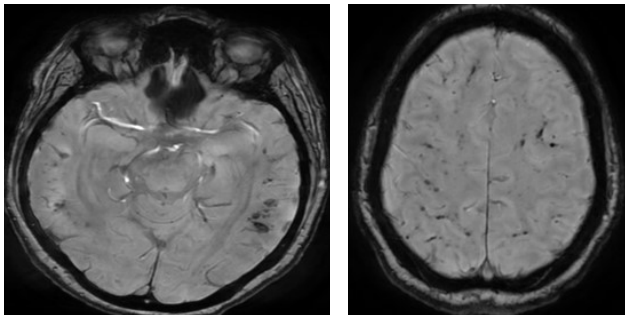

Figure 1. Microhemorrhages in both cerebral hemispheres, predominantly in the cortico-subcortical transition of the frontal, parietal, occipital and temporal lobes.

to strengthen the paretic muscles of the right ankle, as well as proprioceptive and gait training.

There was improvement in dorsiflexor muscle strength (MRC 1 to MRC 3), complaints of pain in the right lower limb and partial improvement in gait pattern. The patient was discharged from physical therapy using a flexible right ankle-foot orthosis for long-distance walking.

After discharge from physical therapy, she started in the weight training group through physical education (twice a week) to perform global muscle conditioning exercises, for a period of two months. Subsequently, the patient was referred to an outpatient clinic to maintain physical activity.

There was an improvement in the gait pattern, and the patient had already discontinued the use of the ankle-foot orthosis. The muscle strength in the last evaluation with physical therapy, performed 2 years and 3 months after the acute stage of COVID-19, showed muscle strength of ankle dorsiflexor grade 4/5, ankle plantar flexor, invertor and evertor grade 3/5 and flexor digitorum and halluces extensors of grade 2/5.

During follow-up, she complained of changes in her memory started after COVID-19. The patient was referred for evaluation by psychology, which included semistructured interviews, specific scales for neuropsychiatric symptoms (the Brazilian version of The Hospital Anxiety and Depression Scale – HAD[8]) and quality of life (the Brazilian version of the WHOQOL-brief[9]), and neuropsychological screening (the Brazilian version of the Montreal Cognitive Assessment – MoCA[10,11]). There were clinically significant indicators of anxiety, dissatisfaction with the physical (pain/sleep/energy) and psychological (mood/concentration) domains and lower-than-expected cognitive functioning. Changes in executive functions, attention skills, language, abstraction and delayed recall were observed.

Therefore, the decision was to start outpatient consultations with Psychology at SMARTLAB, a space provided by the SARAH Network with virtual games aimed at physical and cognitive rehabilitation. The interventions were based on the use of BrainGymmer[12], a virtual platform for cognitive training accessed through registration and licence (purchased or free). The system offers 25 games grouped into 5 cognitive domains (processing speed, working memory, logical reasoning, visual perception, language and planning) with presentation of the overall score obtained at the end of each move. It is noteworthy that the score, by itself, is not a completely descriptive measure of the player's performance, as mediation is necessary during the learning and development phase of the stimulated skills, being an additional resource to the clinical observations.

Patient follow-up in the Smartlab occurred weekly for 5 months, totalling 15 sessions of 60 minutes each. The initial selection of virtual games was based on previous assessments of neuropsychological functioning, seeking to stimulate the areas of greatest loss of skill.

As a complementary evaluative parameter of the program, the Goal Attainment Scaling (GAS)[13] was applied to define SMART goals, that is, specific, measurable, achievable, realistic and time-bound goals. She complained of difficulty with memory, concentration and speed of response: "I'm slow and I forget everything" (sic). The SMART goals were:

- to actively monitor their cognitive process during games (reflect, verbalise impressions) and
- to spontaneously use compensatory strategies taught during games. As strategies to achieve the objectives, the following were adopted:
    - encourage self-assessment and metacognition by mediating their perception of the level of difficulty of the task
    - guide facilitative strategies
    - develop the ability to plan the training and self-monitoring of the sessions
    - instruct the use of the virtual platform at home to regularize cognitive stimulation in the routine

At the end of the program, the GAS scale confirmed the achievement of goals and those that were surpassed (Table 1).

In addition to the positive changes in the scores and classifications identified in the formal instruments at program completion, the positive perceptions of the patient and the team about their general functioning were in agreement.

Below are the qualitative data on SOC performance at the end of the intervention:

Team perceptions

- Autonomy to develop their activity of stimulation and implementation in the routine
- A higher frequency of spontaneous and assertive comments about their performance and external factors that hindered them
- Significant improvement in initiative, sustained attention to competing environmental stimuli, detail discrimination, verbal and executive processing speed
- Greater variation in facial expressions, affect and vocal intonation and in emotional expressiveness as a whole
- Lower frequency of mental fatigue complaints

Table 1. Initial neuropsychological evaluation of SOC patient with 58 years old, diagnosed with COVID-19, 16 months after COVID-19 diagnosis, and final evaluation after 5 months of neuropsychological rehabilitation with virtual games.

	Initial evaluation	Final evaluation
Psychological interview	The patient presented with verbal and motor slowing down, difficulty maintaining conversation, lowered emotional expressiveness and a monotonous tone of voice.	There was an improvement in speech rate, tone of voice and emotional expressiveness, facilitating conversation.
Montreal cognitive assessment (MOCA)	Overall score 19 (suggestive of general cognitive impairment). Changes in executive functions (tracks and clock), attention (seven series), language (repetition and verbal fluency), abstraction and delayed recall were observed.	Overall score 21 (suggestive of borderline general cognitive functioning). It was observed that she maintains significant difficulty related to executive functions, language (verbal fluency, repetition of sentences) and abstraction (categorisation). Improved performance in attention and memory tests.
Hospital depression and anxiety scale (HAD)	Anxiety score: 11 – clinically significant symptoms present Depression score: 07 – no clinically significant symptoms	Anxiety score: 02 – absence of clinically significant symptoms present Depression score: 02 – no clinically significant symptoms
Quality of life scale (WHOQOL-brief)	Physical: 3.0 REGULAR Psychological: 3.7 REGULAR Environment: 4.0 GOOD Social Relations: 4.0 GOOD	Physical: 4.0 GOOD Psychological: 4.0 GOOD Environment: 3.7 REGULAR Social Relations: 4.3 GOOD
Goal attainment scaling (GAS)	Initial 37.60	Final 74.01 – result above expectations

Patient perceptions

- Ability to maintain conversation resumed.
- Selective and sustained attention to competing stimuli improved: *"Now I can maintain focus without being distracted by everything"*.
- She noted initiative to develop her routine activities.
- Processing speed and response time improved.
- It implemented resources such as agendas, reminders and externalised speech for self-monitoring, planning and conference of tasks.
- She perceived emotional self-regulation: *"I was in a traffic accident. I was alone, and I managed to remain calm to seek solutions"*.

There was a resumption of professional and community activities. The patient reported significant improvement in cognitive performance when performing job duties. She gained confidence to drive alone. At the end of the program, she maintained regular participation in a gym in the community (weight training) and daily cognitive training in her home routine.

The patient was discharged from the neuropsychological rehabilitation program with a proposal for periodic appointments with Psychology for follow-up. She performed two consultations with an interval of 2 months, maintaining an active routine without new cognitive demands.

DISCUSSION

The neurological involvement in COVID-19 is already well recognised[14,15], and the SARS-CoV-2 virus is responsible for numerous adverse effects in the central and peripheral nervous systems[3].

This case report addressed the neurological, cognitive and neuropsychological rehabilitation of a patient with Long COVID.

Intracranial haemorrhage is commonly observed in neuroimaging tests in patients with COVID-19[16,17] and may manifest as lobar haemorrhage, microhemorrhages, subarachnoid haemorrhage or subdural haemorrhage[18]. Intracranial haemorrhages can be found in the context of severe sepsis caused by the SARS-Cov-2 virus, and may be related to increased capillary permeability due to the cytokine storm, as well as to coagulation changes secondary to severe COVID-19 (disseminated intravascular coagulation) or to the treatment implemented (use of anticoagulants to prevent thromboembolic events, haemodialysis or use of extracorporeal membrane oxygenation – ECMO)[18]. Based on these data, it is important to highlight that, in this clinical case, the MRI showed microhemorrhage, but in many cases there are no clear explanations for the symptoms. Although long COVID has been detected in many patients, its pathophysiology is often unclear, especially those related to the central nervous system.

The neurological changes resulting from the neuropathy, including neuropathic pain and foot drop, improved with the regular use of pain medications, performance of exercises to strengthen the paretic muscles, and proprioceptive and gait training. The patient resumed performing community movement without restrictions and without the need for orthosis.

Interventions through virtual games (BrainGymmer[12]) available on SMARTLAB/SLZ that involved stimulation, training and compensation of cognitive functions were planned based on the evaluations and objectives outlined with the patient. In this case study, it was observed that the goals extrapolated the context of the sessions, pointing to the transfer of skills.

Scientific evidence consistently shows that interventions in cognitive rehabilitation are able to improve different domains, such as attention, memory and executive functions, after brain damage[19].

In the present study, the quantitative and qualitative data obtained are consistent with the literature, as they indicate an improvement in the patient's general cognitive functioning, although it still does not correspond to normality or previous performance. In addition, executive dysfunction remains and is evidenced in specific neuropsychological tasks, which is also consistent with current evidence[5,20].

Although it was not the focus of the cognitive rehabilitation program, there was a reduction in the score and classification of depression and anxiety indicators during follow-up. It was considered that psychoeducational approaches and complementary psychological support during the sessions, added to the gains obtained in the routine, may have contributed to this result[21].

Finally, the long-term effects and cognitive sequelae of COVID-19 are still uncertain, so it is essential to provide specialised interventions for the management of neuropsychological symptoms as soon as possible.

Therefore, the conclusion is that, despite the limitations of a clinical case, such data are relevant because they demonstrate the positive effects of an intervention program calibrated to the profile of the patient and his or her physical and cognitive demands in the post-COVID period.

AUTHORS' CONTRIBUTIONS

PFA: conceptualization, data curation, formal analysis, project administration, writing – original draft. EHMT: conceptualization, data curation, formal analysis, writing – review & editing. JAMA: conceptualization, data curation, formal analysis, writing – review & editing. RLR:data curation, formal analysis, writing – review & editing.

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