



COVID-19 presenting with agraphia and conduction aphasia in a patient with left-hemisphere ischemic stroke

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Abstract

COVID-19 following infection by SARS-CoV-2 can affect the brain causing confusion, depression, and dementia-like signs. Nonetheless, the presence of more specific neuropsychological signs because of COVID-19 remains unexplored. We report on LA, a patient who was affected by a left-hemisphere ischemic stroke, probably because of SARS-CoV-2. The patient showed a highly specific neuropsychological profile characterized by severe agraphia and some signs of conduction aphasia. All other cognitive and sensorimotor functions remained intact. We sustain that specific neuropsychological signs can be observed in patients with COVID-19. Therefore, in-depth and comprehensive neuropsychological assessment should be included to better explore and qualify the neuropsychological consequences of COVID-19. This is a new challenge for diagnosis and rehabilitation, with important consequences for the involved neuropsychological services.

Keywords COVID-19 · SARS-CoV-2 · Conduction aphasia · Agraphia

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), resulting in corona virus disease 2019 (COVID-19), has caused a pandemic. Indeed, more than 950,000 deaths have been reported world-wide (<https://covid19.who.int/>). Although COVID-19 is mainly characterized by severe pulmonary signs, there is now growing evidence that the brain can be also affected [1, 2]. Indeed, neurological disorders have been reported in patients with COVID-19. These disorders include brain inflammation, hyposmia/hyposgeusia, Guillain-Barré syndrome, and stroke [1, 2]. Confusion, agitation, dementia-like signs, and psychotic signs following COVID-

19 have been also described [1, 2]. Furthermore, Helms et al. [3] have reported the presence of dysexecutive syndromes in 14 out of 39 patients affected by COVID-19. Nevertheless, the presence of more focal neuropsychological disorders (e.g. aphasia, agraphia, alexia, agnosia, and neglect), following SARS-CoV-2, remains a largely unexplored issue. Therefore, in the present study, we aimed to investigate, more in depth, the specific and focal neuropsychological consequences of SARS-CoV-2, in a patient affected by left-hemisphere stroke.

Case report

The study was conducted according to the principles of the Declaration of Helsinki. The patient gave his informed consent to participate. LA was a 53-year-old, right-handed male, with 8 years of education. On April 6, 2020, after 2 weeks of fever, the patient was admitted to an emergency room with signs of aphasia and behavioural agitation. A chest X-ray scan revealed the presence of mild interstitial pulmonary signs. Serological tests (IgG Ab) confirmed the presence of antibodies for SARS-CoV-2. FLAIR-MRI imaging revealed the presence of hyperintense signal in the temporo-parieto-insular regions of the left hemisphere extending subcortically to the homolateral semioval centres (Fig. 1). This signal was compatible with an ischemic stroke

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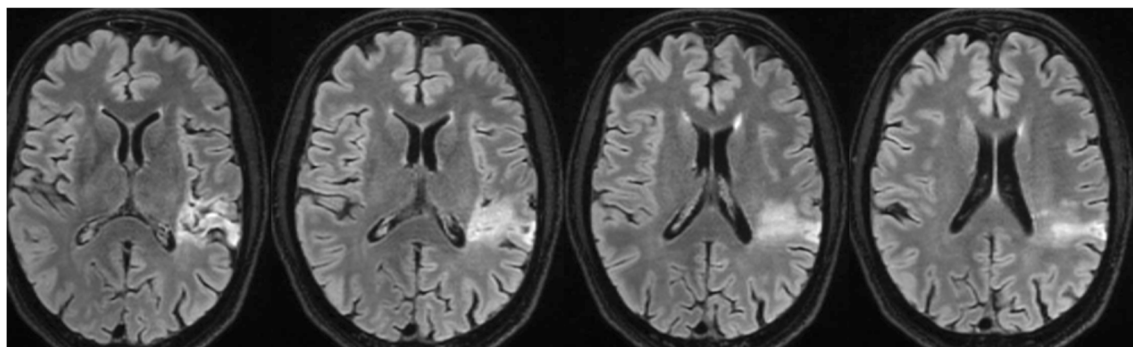


Fig. 1 FLAIR-MRI scan of LA's brain, showing hyperintense signal in the left temporo-parieto-insular region, extending to the homolateral semioval center

Table 1 Language, number processing and calculation [4]

	Range	Corrected score	Cut-off	Diagnosis
-Oral repetition				
-Words	0–10	10	8.8	Normal
-Non-words	0–5	3.8	2.0	Normal
-Sentences	0–3	1	3.0	Abnormal
-Reading aloud				
-Words	0–10	10	6.4	Normal
-Non-words	0–5	5	4.0	Normal
-Sentences	0–2	2	1.3	Normal
-Writing to dictation				
-Words	0–10	5.9	6.3	Abnormal
-Non-words	0–5	0.6	1.4	Abnormal
-Sentences	0–2	0	0.6	Abnormal
-Naming				
-Nouns				
-Oral naming	0–10	10	8.2	Normal
-Written naming	0–5	2.9	2.7	Normal
-Verbs				
-Oral naming	0–10	8.9	6.1	Normal
-Written naming	0–5	3.8	3.0	Normal
-Colors				
-Spoken naming	0–5	5	4.0	Normal
-Comprehension				
-Single words				
-Oral comprehension	0–20	20	18.4	Normal
-Written comprehension	0–20	18.9	17.0	Normal
-Sentences				
-Oral comprehension	0–14	14	11.6	Normal
-Written comprehension	0–14	14	11.3	Normal
-Number processing				
-Repetition	0–10	10	8.8	Normal
-Reading aloud	0–10	8.3	7.6	Normal
-Writing	0–8	8	6.3	Normal
-Transcoding number words to Arabic digits	0–8	8	4.2	Normal
-Calculations				
-Additions	0–3	3	2.2	Normal
-Subtractions	0–3	1	1.0	Normal
-Multiplications	0–4	2.4	1.4	Normal
-Verbal fluency				
-F	0–∞	6.9	5.7	Normal
-A	0–∞	2.9	4.8	Abnormal
-S	0–∞	5.9	5.8	Normal
-Animals	0–∞	18.8	10.3	Normal
-Objects	0–∞	14.7	8.5	Normal
-Nouns	0–∞	17	7.0	Normal
-Verbs	0–∞	10.2	5.7	Normal

Table 2 Praxis and Token test [5]

	Range	Raw score	Corrected score	Equivalent score	Cut-off	Diagnosis
Praxis						
Ideomotor apraxia (left upper limb)	0–20	20	20	4	0	Normal
Ideomotor apraxia (right upper limb)	0–20	20	20	4	0	Normal
Constructional apraxia	0–14	14	14	4	0	Normal
Comprehension						
Token Test	0–36	34.5	33.5	4	0	Normal

of the middle cerebral artery probably because of thrombophilic processes, probably elicited by SARS-CoV-2. The signal, indeed, appeared discontinuous, and it was characterized by thromboembolic elements distributed in different divisions of the middle cerebral artery (M3, M4). Finally, the midline brain structures were normally aligned and there was no evidence of hemorrhagic conversion.

LA was admitted to our neurorehabilitation unit to receive comprehensive neuropsychological assessment concerning his left-hemisphere syndrome. His previous medical history was unremarkable, except for a visual deficit in the left eye. Neurological examination did not reveal sensory or motor deficits, but LA had a fluctuating sense of temperature in his right hemisoma. LA was alert, collaborative, and aware of his linguistic difficulties. The patient was fully oriented to time, space, and person. Furthermore, he did not show signs of mnemonic or executive dysfunction in everyday life.

A comprehensive neuropsychological assessment was then performed (see Tables 1 and 2). LA's praxis was normal: the patient did not show any signs of ideomotor or constructional apraxia. His oral production was fluent, both with reference to spontaneous tasks (i.e. conversation) and to elicited tasks (i.e. picture description; semantic and phonemic verbal fluency, except for phoneme A). Articulatory and prosodic deficits were absent. The syntactic structure of LA's utterances was intact, suggesting the absence of agrammatism. His oral and written comprehension was intact, both for single words and for sentences (see also Token test, Table 2). Number processing and calculation were also intact. Oral and written naming of pictures representing nouns, verbs, and colours was largely spared. Nevertheless, LA produced some phonological paraphasias and he made attempts to self-correction (conduit d'approach).

In contrast, LA showed some signs of conduction aphasia. Although oral repetition of spoken single words and non-words was intact, the patient was severely impaired in orally repeating spoken sentences. Reading aloud words, non-words, and sentences was intact. On the contrary, writing was severely impaired. More precisely, on writing to dictation, the patient produced many paraphasias, which were mainly characterized by

the omission or substitution of graphemes. Paraphasias were present for single words, non-words, and sentences.

Discussion

LA had a largely intact neuropsychological profile, except for the presence of severe agraphia and some signs of conduction aphasia. These deficits were fully compatible with the presence of a temporo-parieto-insular lesion documented by FLAIR MRI. Of course, special caution is required about the pathogenic role of COVID 19 in our case, which is suspected, but cannot be directly demonstrated. LA's stroke, however, might have been elicited by SARS-CoV-2 for three reasons. First, LA was simultaneously affected by thromboembolic events in distinct sites (M3, M4). Second the patient was not affected by risk factors for stroke (e.g. hypertension and diabetes). Finally, LA's medical history was unremarkable.

We suggest that patients affected by SARS-CoV-2 and stroke might not only show diffuse neurocognitive and neurobehavioural signs (e.g. confusion, agitation, psychosis), but they can also present with highly focal neuropsychological disorders, such as agraphia and conduction aphasia. Therefore, in-depth and comprehensive neuropsychological assessment should be performed in these patients to better explore and qualify the neuropsychological consequences of COVID-19. This is a new and important challenge both for neurologists and clinical neuropsychologists involved in the diagnosis and treatment of the consequences of COVID-19.

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Compliance with ethical standards

Ethical approval The study was conducted according to the principles of the Declaration of Helsinki. The patient gave his informed consent to participate.

Conflict of interest The authors have no conflicts of interest to declare that are relevant to the content of this article.

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