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Thalamic aphasia and SARS-CoV-2 infection (COVID-19)

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Abstract

Damage to the thalamus that results in thalamic aphasia, a language disability, is typically associated with vascular events, tumours, or degenerative disorders. There is growing interest in examining the relationship between COVID-19 and thalamic aphasia due to its association with several neurological problems, including strokes and minor lesions that may affect the thalamus. The virus's ability to induce hypercoagulable states and systemic inflammation, which may result in thalamic ischemic strokes and interfere with language processing networks, has sparked this interest. In light of the COVID-19 pandemic's continuous nature, more investigation is necessary to fully comprehend the virus's neurological effects, particularly any potential connections to thalamic aphasia, in order to diagnose and treat thalamic aphasia, forecast language recovery, and customise rehabilitation plans for those affected, including those recuperating from COVID-19-related neurological complications.

Keywords: Thalamic aphasia; COVID-19; Stroke; SARS-CoV-2

1. Introduction

1.1. Thalamic aphasia and COVID-19

Thalamic aphasia, a language disorder resulting from damage to the thalamus, is typically associated with vascular events, tumours, or degenerative diseases. The relationship between thalamic aphasia and COVID-19 would be an emerging area of study, as COVID-19 has been associated with a range of neurological complications. These complications can arise due to the virus's direct effects on the nervous system, immune responses leading to inflammation, or complications from the body's systemic response to infection, including hypercoagulability leading to strokes.

COVID-19 has been linked to cerebrovascular events, including strokes and typically small lesions, which can affect the thalamus and lead to thalamic aphasia [1-3]. The virus may contribute to hypercoagulable states, increasing the risk of ischemic strokes, which could involve the thalamus and disrupt the language networks connected to it. Additionally, the systemic inflammation and immune-mediated responses seen in severe COVID-19 cases could lead to diffuse neurological damage, including areas involved in language processing [4,5].

1.2. Pathophysiology of Thalamic Aphasia

Thalamic aphasia is a language dysfunction associated with lesions that exclusively affect the thalamus, typically on the left side. It can develop in isolated haemorrhages and ischemic strokes, and less frequently, it has been described in cases of malignant neoplasms involving the thalamus and in neurosurgical interventions. The clinical presentation of thalamic aphasia varies and can present as global aphasia, expressive aphasia, or transcortical aphasia, with

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transcortical motor aphasia (hesitant and fragmented speech) or transcortical sensory aphasia (poor comprehension, semantic paraphasias, and echolalia) being the most common presentations [6]. A distinguishing feature of both transcortical aphasias and a notable feature of thalamic aphasia is that repetition is intact and wholly preserved [7].

It occurs more frequently after lesions affecting the left (dominant) thalamus. However, aphasia on the right side has also been observed in lesions in left-handed patients [8]. It has been proposed that the disconnection of thalamic projections to language-related cortical regions is the underlying mechanism of the language deficit associated with thalamic lesions [9]. However, the exact pathophysiological mechanism for the development of thalamic aphasia remains controversial [10].

The occurrence of thalamic aphasia about vascular lesions underscores the critical role of thalamic nuclei and their vascular supply in language processing. Thalamic aphasia can arise from disruptions in various thalamic regions, each supplied by distinct vascular territories. The distinction in aphasia onset between haemorrhagic events in the posterior thalamus, particularly the pulvinar, and infarcts in the anterior thalamic circulation, serviced by the tuberothalamic artery affecting the ventral and anterior nuclei, is noteworthy [11].

This differentiation suggests that the location and nature of vascular lesions within the thalamus have significant implications for the type and severity of language deficits observed. Haemorrhages affecting the posterior thalamus, including the pulvinar, are more frequently associated with the onset of thalamic aphasia, highlighting the role of the pulvinar in language networks. In contrast, infarcts in the anterior thalamic circulation, which impact the ventral and anterior nuclei, may result in different or less pronounced language deficits.

The pulvinar, part of the posterior thalamic region, is involved in various complex functions, including language processing, attention, and sensory information integration. Its significant role in language might be attributed to its extensive connectivity with cortical language areas, thereby making it more susceptible to language deficits following a haemorrhage. On the other hand, the anterior thalamic nuclei, supplied by the tuberothalamic artery, are more involved in memory and executive functions, which might explain the different clinical presentations following infarcts in this area.

Recent advances in functional neuroimaging techniques (functional magnetic resonance imaging and magnetoencephalography) allow more precise conclusions about the role of the thalamus in language processing. For instance, a tractography study showed that Broca's area is structurally connected to the thalamus (ventral anterior nucleus and pulvinar) and suggested that this network is involved in language processing [6]. Another study suggested that aphasia associated with thalamic lesions is consistent with the "selective engagement model" proposed by Crosson et al. [12]. This model proposed that the thalamus controls and integrates activity in language-related cortical areas (receptive and expressive).

Other linguistic models suggested different roles of the thalamus in language, including selecting alternative words, semantic control, and releasing formed responses in the cortex [13]. It is also worth mentioning that some studies have described cortical hypoperfusion in language regions in some cases of thalamic aphasia, which may indicate a contribution of cortical dysfunction in the neural basis of thalamic aphasia [14].

It has been suggested a set of clinical criteria to aid in the diagnosis of thalamic aphasia:

- Fluent expression with frequent paraphasias (mainly semantic)
- Jargon (severe paraphasia)
- Less severe deficits in auditory comprehension
- Intact or minimally impaired repetition [7].

Functional neuroimaging research will be helpful in revealing the relationship between the thalamus and language and the specific neural bases of thalamic-origin aphasia. From a clinical standpoint, physicians use a battery of neuropsychological tests to comprehensively evaluate aphasias (spoken language, writing, and reading comprehension) [15].

2. Conclusion

Given the novelty and ongoing nature of the COVID-19 pandemic, the specific mechanisms and prevalence of thalamic aphasia as a complication remain an area for further research. Studies focusing on the neurological impacts of COVID-

19 would be crucial to understanding the full spectrum of its effects, including any direct or indirect associations with thalamic aphasia. On the other hand, understanding the vascular anatomy of the thalamus and its functional connectivity with cortical regions is crucial for diagnosing and managing thalamic aphasia. This knowledge helps predict language recovery, tailor rehabilitation strategies to individual patients, and manage post-COVID neurological syndromes based on the specific thalamic nuclei and vascular territories involved and the pathophysiology of SARS-CoV-2 mediated cerebrovascular diseases.

Compliance with ethical standards

Disclosure of conflict of interest

The authors have no competing interests to declare that are relevant to the content of this article.

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