SRYAHWA PUBLICATIONS

Archives of Neurology and Neuro Disorders
ISSN: 2638-504X | Volume 5, Issue 1, 2025
https://doi.org/10.22259/2638-504X.0501002

CASE REPORT

Cerebellar Aphasia: A Case Report

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Received: 09 May 2025 Accepted: 23 May 2025 Published: 29 May 2025

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Abstract

The cerebellum has a widely understood motor function, but since the 1980s, its involvement in cognitive functions has been studied. The main problems affected in patients with cerebellar lesions are grammatical structure failures, the comprehension of syntactically complex sentences, and impaired verbal fluency. Objective: To present a clinical case of cerebellar aphasia and the language impairments presented. Case presentation: We describe the case of a 31-year-old patient who presented cerebellar degeneration as a paraneoplastic syndrome due to non-Hodkin's lymphoma. The Western aphasia test was administered, as well as conceptual language proficiency. A qualitative analysis of expressive and receptive speech was performed. Discussion: It is important to consider the involvement of the cerebellum in cognitive functions, primarily language, which may present as deficiencies in expressive and receptive language. Conclusion: Cerebellar aphasia is a little-known pathology, with primary involvement in morpho-syntax, semantic association and verbal fluency, requiring multidisciplinary management and comprehensive assessment.

Keywords: Cerebellum, Cerebellar Aphasia, Verbal Fluency.

1. Introduction

Traditionally, the cerebellum has been considered an organ primarily dedicated to motor coordination. However, recent research has broadened this view, suggesting that the cerebellum also plays a crucial role in complex cognitive processes, including language. Anatomically, the cerebellum is located in the posterior fossa of the skull, connected to the brainstem through the cerebellar peduncles. It is composed of two lateral hemispheres and a central structure called the vermis. The cerebellar cortex is organized into three layers: molecular, Purkinje, and granular, with Purkinje cells playing a crucial role in modulating neuronal activity. Reciprocal connections with cortical areas, such as Broca's area, have been shown to allow the cerebellum to influence linguistic functions, such as cognition.

The concept of "cerebellar cognition" suggests that the cerebellum modulates neurocognitive processes in the associative cortex. This is due to its extensive network of connections with the cerebral cortex, which allows it to influence cognitive functions beyond motor functions. (1) Neuroimaging and lesion studies have shown that the cerebellum is involved in speech execution and higher-level linguistic processes, such as word generation and comprehension of grammatical structures. This indicates that its role is not limited to motor articulation. (2)

Cases have been documented in which lesions in the cerebellum, especially in the right hemisphere, have

Citation: Paulina Concepción Murphy-Ruiz, Luis Fernando Galindo Borbón, Victor Damian Lozano Flores, *et al*. Cerebellar Aphasia: A Case Report. Archives of Neurology and Neuro Disorders. 2025; 5(1): 4-7.

caused aphasic syndromes. This suggests an indirect interaction with the language-dominant hemisphere, affecting linguistic functions. (3)

It is proposed that the cerebellum, especially the right hemisphere, does not generate language, but rather modulates linguistic processes. It acts as an intermediary between cognitive functions and their execution, coordinating information from brain areas responsible for language. (5)

There is a connection through the cerebelloponto-thalamo-cerebrocortical pathways, suggesting that cerebellar lesions may cause functional damage to the brain areas that process language, due to the reduction of input through the cerebellar-cerebral pathways. This implies that the language deficits observed after cerebellar lesions are not directly caused by damage to the cerebellum, but rather by the involvement of supratentorial areas. (5)

The cerebellum does not directly influence language but plays a crucial role in the timing of linguistic functions. This means that the cerebellum helps regulate the rhythm and sequence of linguistic processes, experiencing great difficulty in temporal modulation, which is necessary for various linguistic processes such as phonological processing, sentence construction, and the understanding and application of syntactic rules (5).

It is actively involved in the organization and execution of linguistic processes, not only as a modulator, but as a participant in language construction (5).

2. Case Presentation

A 31-year-old Mexican man with right-handedness, high school education, occupation: disc jockey, native Spanish, and no other idiom domain. He was referred to our institution with a history of non-Hodgkin's lymphoma treated with 12 cycles of chemotherapy. In August 2021, he began experiencing paresthesias in his right hand and foot, followed by speech difficulties characterized by slow speech and flattened tone, with a slow progression of symptoms. In September 2021, the patient was admitted to the National Institute of Neurology and Neurosurgery, where a conclusive diagnosis could not be established. After the lymphoma diagnosis in January 2022, the patient began chemotherapy treatment; however, neurological symptoms persisted, including speech problems and an ataxic gait. Currently, the patient's speech is non-fluent, with frequent articulation errors, although he is intelligible to those around him. Communication is supported through sentence restructuring.

On clinical examination, he was alert, reactive, oriented in time, person, and space, and had a normal-hearing auditory behavior. His voice was low-pitched, bright, and of adequate intensity. His language was non-fluent, with adequate coherence but limited cohesion. His speech was dysprosodic, with articulation errors and a slow pace. No difficulties with speech comprehension were demonstrated. The neurological examination revealed the following findings: spontaneous and gaze-evoked nystagmus. Inadequate saccadic and optokinetic pursuit. Inadequate suppression of the vestibulo-ocular reflex (VOR). Hypotonia of the tongue with fasciculations. Decreased strength in all four extremities, with preserved sensibility.

A Western aphasia test and tests to assess conceptual language domain were administered (Table 1), as well as an MRI, which showed a decrease in volume in the cerebellar hemispheres and vermis, consistent with paraneoplastic cerebellar degeneration (Figure 1). Based on the objective and subjective clinical findings, a diagnosis of cerebellar aphasia secondary to paraneoplastic cerebellar degeneration was made. Language therapy was indicated. The patient attended therapy for six months, with two 50-minute sessions per week, with significant progress.

Table 1. *Neuropsychological Evaluation*

Western Aphasia Test		
I	Spontaneous language	Non-fluent, with agrammatism and articulation errors. Speech with fewer than 50 items per minute. Sentences of fewer than five words, with errors in verb inflections and omission of verbs, articles, and prepositions.
II	Verbal Comprehension	Suitable for simple and complex orders, with difficulties in passive and subordinate constructions.
III	Repetition and Denomination	Adequate, although with the presence of visual paraphasias.
IV	Verbal Fluency	Open category: can name 34 items in 2 minutes. Phonological fluency (letter p): can name 10 items in 2 minutes. Semantic fluency: can name 33 items in 2 minutes.
V	Reading and Writing	Adequate reading comprehension for short sentences; writing was not achieved due to motor problems.

Conceptual Language Domain		
VI	Idiomatic expressions	Correct interpretation of 6 out of 10
VII	Verbal nonsensical phrases	Correctly answer 7 out of 10 correct answers
VIII	Word association	In the first attempt, he gives eight associative relationships of the coordination and superordination type, and two distant responses. In the second attempt, he manages to say the same words for all the elements.
IX	Semantic discrimination	Performed regularly

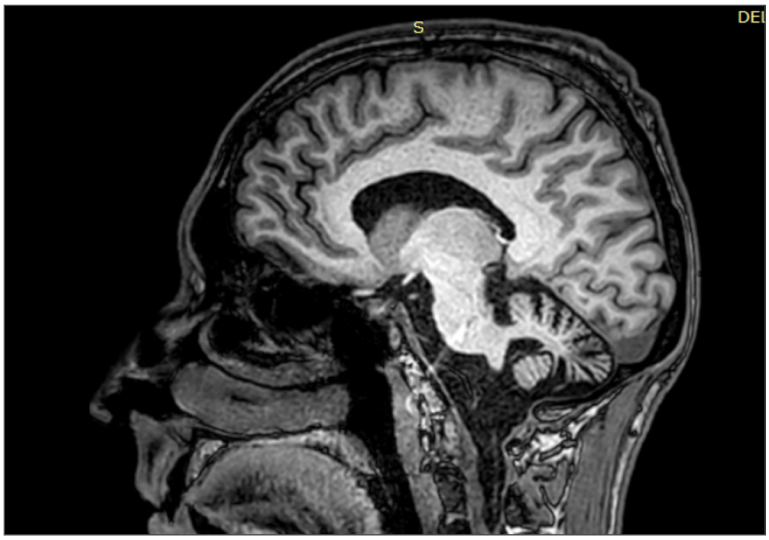

Figure 1. *MRI, which showed a decrease in volume in the cerebellar hemispheres and vermis, consistent with paraneoplastic cerebellar degeneration*

3. Discussion

The initial evaluation of a patient with cerebellar injuries and the methods for assessing the involved functions are described. Cerebellar injuries can cause different clinical profiles, creating a diagnostic challenge, requiring the use of specific batteries and analysis of narrative and conversational discourse.

It is important to consider that although the motor role of the cerebellum remains highly important, associated cognitive functions have been discovered since 1980, including language modulation. The mechanisms by which the cerebellum affects cognition are still not fully understood, but additional deficits in visuospatial functions, memory, and language have been found as a result of the injury (6).

The cerebellum is therefore involved in language production, primarily in verbal initiative and morphosyntax. Agrammatism, loss of verbal conjugation, and omission of connectives have been reported in cerebellar damage. It is believed that complex syntactic sentences are represented in posterior association areas and require temporal modulation, involving the contralateral cerebellar hemisphere (7). Oral comprehension and semantic association are affected in individuals with damage to the right cerebellar hemisphere (8).

Regarding verbal fluency, there are no conclusive findings indicating cerebellar involvement. It has been reported that the right cerebellar hemisphere activates in conjunction with left frontoparietal areas when an individual is asked to recall words related to a semantic field, but primarily related to phonology. These characteristics are present in the patient reported, in addition to imaging evidence that allows clinical and imaging correlation to determine the diagnosis of cerebellar aphasia and be able to indicate the correct treatment.

4. Conclusions

The cerebellum plays a crucial role not only in motor coordination. It is necessary to further understand its involvement in language, as this could revolutionize our understanding of physiology and provide new guidelines for rehabilitation.

Ethical Considerations

Informed consent was obtained from the patient for this presentation.

Conflict of Interest

The authors declare no conflict of interest.

Funding

We declare that there was no source of funding for the conduct of this research or for the preparation of this manuscript.

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