



Aphasia following cerebellar damage: fact or fallacy?

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Abstract

During the past two decades, converging neuroscientific evidence has established the view that the human cerebellum participates in a much wider range of functions than conventionally accepted. As a consequence, the concept of ‘cerebellar cognition’ evolved from a mere afterthought to an exciting new multifaceted area of contemporary cognitive neuroscientific investigations. One of the major avenues of current research is the role of the cerebellum in non-motor language processing. Evidence from both neuroimaging and lesion-behaviour studies indicate that aside from its function in the execution of motor speech the cerebellum is also engaged in the processing of language at a higher level than the articulatory one. In this contribution we focus on this topic by an illustrative case in which an ischaemic lesion in the vascular territory of the right arteria cerebellaris superior induced a prefrontal aphasic syndrome and an agrammatism. In the total absence of any neuroradiological evidence for a structural lesion in the left frontal language areas, the hypothetical causative role of the right cerebellar lesion on the contralateral prefrontal aphasic symptomatology is advocated and supported by positive ^{99m}Tc-hexamethylpropyleneamine oxime single-photon emission-computed tomography findings (^{99m}Tc-HMPAO SPECT), revealing focal hypoperfusions in the clinically suspected areas. During longitudinal follow-up the regression of crossed cortical and subcortical left hemisphere diaschisis demonstrated by SPECT paralleled the changes in the neurolinguistic profile. The presented case adds evidence to the view that the phenomenon of so-called ‘crossed cerebello-cerebral diaschisis’, reflecting the distant functional impact of the right

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cerebellum on the contralateral prefrontal cortical areas, can be associated with an aphasic substrate. The co-occurrence of a right cerebellar lesion and an aphasic syndrome illustrates the pathophysiological hypothesis of a deactivation of prefrontal left hemisphere language functions due to the loss of excitatory impulses through cerebello-ponto-thalamo-cortical pathways. © 2000 Elsevier Science Ltd. All rights reserved.

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1. Introduction

As the result of a long-standing doctrine in neurology which posits that the cerebellum is only engaged in motor aspects of human behaviour, our understanding of the cerebellar contribution to cognition is currently still in a preliminary stage. However, during the last two decades the collaboration across disciplines and the methodologic and conceptual advances of contemporary neuroscience have brought about a substantial increase of knowledge in this field. A growing body of evidence from distinct neuroscientific disciplines convincingly shows that the traditional view of the cerebellum, as serving an exclusively automatic and somatic motor function, is no longer tenable.

Identification of extensive anatomical connections between the cerebellum and the association areas of the primate cortex [1–4] grounded the hypothesis that the cerebellum might modulate neurocognitive processes of at least these parts of the brain to which it is reciprocally connected. From the mid-1980s onwards an impressive number of experimental and clinical studies have explored this hypothesis. Consequently, physiological observations in animal models of cerebellar pathology, clinical and experimental neurocognitive investigations, and functional brain imaging studies using Photon Emission Tomography (PET), SPECT, functional Magnetic Resonance Imaging (fMRI) and regional Cerebral Blood Flow (rCBF) activation procedures have become available that substantiate the implication of cerebellar output channels in a variety of higher brain functions (for reviews see [5]). In 1989, Petersen and co-workers [6] reported the findings of presumably the first non-motor linguistic PET activation study in which subjects were requested to associate a presented noun with an appropriate verb and to say this verb aloud. In contrast to the control condition in which the nouns only had to be read or merely repeated, the verb generation condition unexpectedly activated an area within the right lateral cerebellum. In further contrast to the control condition, the verb generation task additionally activated a number of frontal regions in the left hemisphere. Despite variations on the task design, similar language activation studies (e.g. [7–11]) consistently reproduced these findings and have added evidence to the hypothesis that the right cerebellum participates in non-motor linguistic processing. Motivated by the findings of these experimental studies, a variety of word retrieval and word production deficits have been reported in clinical studies of patients with cerebellar pathology (e.g. [12–

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