Severe cognitive Disorders after Bilateral Infarction in the Cerebellum

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The role of the cerebellum in cognitive function has been under debate. Anatomical, physiological, and functional neuro-imaging studies suggest that the cerebellum participates in the organization of higher function, but there are few descriptions of clinically relevant cases that address this possibility [1]. Experimental studies have demonstrated that in normal subjects, the cerebellum is activated in cognitive processing tasks, and that different areas of the brain are activated in motor tasks. Neuronal activity within basal ganglia and cerebellar loops with motor areas of the cerebral cortex is highly correlated with parameters of movement, while neuronal activity within basal ganglia and cerebellar loops with areas of prefrontal cortex is related more to aspects of cognitive function [2]. In our study, impairment in executive functions and visuospatial abilities was found in 15 cases of cerebellar stroke, compared to 15 control patients [3]. Cognitive deficits were also revealed in patients with different degenerative cerebellar conditions [4].

PATIENT DESCRIPTION

A 50 year old woman, who was born in India but had been living in Israel for many years, with no previously known brain lesions, was admitted to the hospital complaining of headache, vertigo, general weakness, and instability during weight bearing. In the computerized axial tomography scan, she had simultaneous infarction in both hemispheres of the cerebellum with no other brain lesions [Figure 1A]. She was hospitalized in the department of neurosurgery and treated by craniotomy and decompression of the posterior fossa [Figure 1B]. During 2 months of in-hospital rehabilitation post-surgery, tests performed by occupational therapists uncovered an array of cognitive disorders. The Cognitive Status Examination (Cognistat) assessment found mild impairment in orientation at time and place, orders comprehension, verbal short-term memory, and problem solving. The screening found moderate impairment in attention, short-term memory, calculation, abstract reasoning, and visual-motor organization. The Rivermead Behavioral Memory Test (1st version translated to Hebrew, 1991) revealed severe impairment in short-term functional memory and in immediate and short-term verbal memory, and moderate impairment in short-term visual memory. The speech therapist found hypophonic voice, inability to carry out complicated orders, and inability to execute phonemic analysis.

COMMENT

We evaluated the cognitive functioning of a woman with acute lesions in both cerebellar hemispheres during 2 months of rehabilitation. Her neuro-behavioral deficits occurred in concomitance with the cerebellar motor syndrome. Schmahmann and Sherman [1] maintained that behavioral changes were clinically prominent in patients with lesions involving the posterior lobe of the cerebellum and the vermis. They described the cognitive disorders of a 62 year old man after bilateral cerebellar stroke, some of which we found in our patient. These difficulties included impair-
ment in the visuospatial skills, verbal short-term memory capacity, abstract reasoning and complex problem solving. Hokkanen et al. [4] examined 26 patients with exclusive cerebellar lesions and found that patients with left cerebellar lesions were slow in a visuospatial task, whereas those with right cerebellar lesions had verbal memory difficulty. These cognitive problems are similar to those of our patient, who has right and left cerebellar hemispheric lesions.

According Schmahmann and Caplan [5] neuro-behavioral problems are characterized by impairment of executive functions, spatial cognition, and linguistic processing when lesions involve the hemispheric regions of the cerebellar posterior lobes. There is increasing recognition that the cerebellum contributes to cognitive processing and emotional control in addition to its role in motor coordination.

Anatomical and physiological studies reveal that cerebral association areas sub-serve higher order behavior and are linked preferentially with the lateral hemispheres of the cerebellar posterior lobe, in feed-forward loops via the nuclei of the basis pons, and in feedback loops from deep cerebellar nuclei via the thalamus. There are also reciprocal connections between the cerebellum and hypothalamus. These pathways facilitate cerebellar incorporation into the distributed neural circuits governing intellect, emotion and autonomic function in addition to sensory-motor control [5].

CONCLUSIONS
The pattern of deficit observed in bilateral infarcts highlights the non-motor functions of the cerebellum. This observation has clinical relevance for patients with cerebellar lesions with impairments in reasoning, problems solving, short-term memory, visual-spatial organization, and linguistic processing.

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References