Toxic-Metabolic, Nutritional, and Medicinal-Induced Disorders of Cerebellum

Nadejda Alekseeva, MD[a], Jeanie McGee, DHEd, MSHS[b], Roger E. Kelley, MD[c], Amir Hadi Maghzi, MD[d], Eduardo Gonzalez-Toledo, MD, PhD[e], Alireza Minagar, MD[a,*]

KEYWORDS

• Cerebellum • Ataxia • Atrophy • Thiamine deficiency • Phenytoin • Ethanol

KEY POINTS

- A number of toxic, metabolic, nutritional, and medicinal insults may affect the cerebellum.
- Acute alcohol intoxication, chronic alcoholism, anticonvulsant therapy, and thiamine deficiency are among the more common causes of cerebellar dysfunction.
- Metabolic explanations for cerebellar dysfunction can include hypoglycemia and hypothyroidism, as well as pronounced electrolyte disturbance.
- Illicit drugs such as cocaine, heroin, and phencyclidine can result in cerebellar damage.
- Poisoning with a number of agents, including carbon monoxide and insecticides, can affect the cerebellum.
- Rapid assessment and management of patients with toxin- and metabolic-induced disorders of the cerebellum can have an important impact on outcome.

INTRODUCTION

The human cerebellum is situated behind the pons and medulla within the posterior cranial fossa and is composed of 2 vastly convoluted hemispheres and a narrow medial section known as the vermis. The cerebellar vermis (derived from Latin word for worm) is situated in the corticonuclear zone of the cerebellum (**Fig. 1**). Three pairs of dense fiber bundles known as peduncles connect the cerebellum to the brain. Despite extensive research into the role of the cerebellum in human

[a] Department of Psychiatry, Overton Brooks VA Medical Center, 510 East Stoner Avenue, Shreveport, LA 71101, USA; [b] Department of Neurology, LSU Health Sciences Center, 1501 Kings Highway, Shreveport, LA 71103, USA; [c] Department of Neurology, Tulane University, 1430 Tulane Avenue, #8065, New Orleans, LA 70112, USA; [d] Department of Neurology, University of California, 350 Parnassus Avenue, San Francisco, CA 94117, USA; [e] Department of Radiology, LSU Health Sciences Center, Shreveport - 1501 Kings Highway, Shreveport, LA 71103, USA
* Corresponding author. LSUHSC-Shreveport, 1501 Kings Highway, Shreveport, LA 71130.
E-mail address: aminag@lsuhsc.edu

Neurol Clin 32 (2014) 901–911
http://dx.doi.org/10.1016/j.ncl.2014.07.001 **neurologic.theclinics.com**
0733-8619/14/$ – see front matter

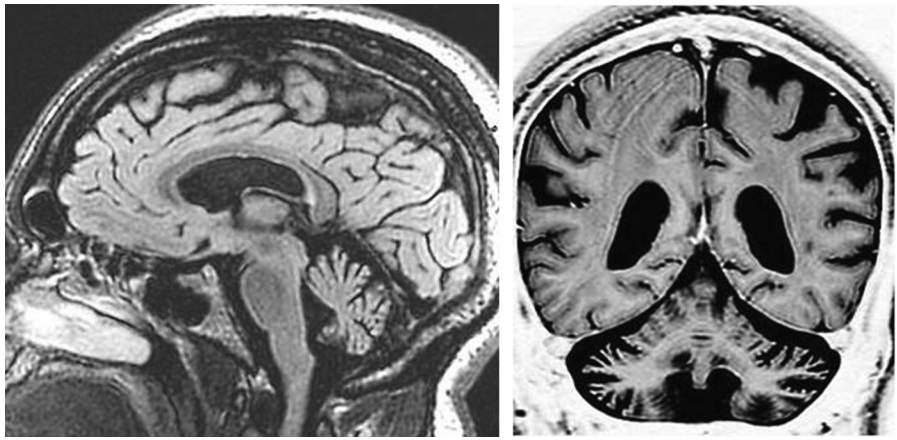

Fig. 1. (*Left*) Magnetic resonance imaging, fluid-attenuated inversion recovery sequence, coronal view showing a remarkable decrease in volume of the cerebellar vermis. (*Right*) Coronal inverted T2 weighted image shows decreased volume of the cerebellum, and hypoplastic vermis.

motor control and cognition, the exact mechanisms of its activities are only marginally understood. The cerebellum receives significant input from cerebral cortical and subcortical regions as well as the spinal cord. Such circuitry allows the cerebellum to have extensive information from the somesthetic, vestibular, visual, and auditory sensory systems, as well as from motor and nonmotor regions of the cerebral cortex.

Although the afferent connections are more substantial the efferent projections, the cerebellum possesses widespread outgoing connections to many regions of the brainstem, midbrain, and cerebral cortex. The cerebellum does not initiate motor activity; however, it does interact with many regions of the brain where movements are initiated to ensure that such motor activity is performed in a coordinated fashion. Like other components of the human brain, the cerebellum is sensitive and vulnerable to a wide gamut of pathologic processes that can lead to cerebellar dysfunction. In addition, a number of pathologies specifically affect the cerebellum. Insult to the cerebellum can result in a constellation of neurologic deficits, including:

- Ataxia (truncal, limb, and gait);
- Hypotonia;
- Dysarthria; and
- Ocular motility problems (including nystagmus and tremor).

The cerebellum is particularly susceptible to the toxic effects of metabolic and medicinal insults; the cerebellar cortex and Purkinje neurons are particularly vulnerable.[1] In susceptible individuals, the most frequent etiology for a toxic abnormality of the cerebellar function stems from acute alcohol poisoning as well as alcoholism. The cerebellum is potentially sensitive to drug exposure, such as anticonvulsants, antineoplastics, lithium salts, and calcineurin inhibitors; to illicit drugs, such as cocaine, heroin, phencyclidine; and to environmental poisons, such as mercury, lead, manganese, and toluene/benzene derivatives. Thus, the astute clinician must be aware of the multiple potential factors that can adversely affect cerebellar function. This will obviously guide timely and effective management with efforts to prevent long-standing disability or even death.