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Controversy

Law of denervation and spinal mechanism of leg movements in sleep
Commentary on controversies in sleep medicine
Montplaisir et al.: Periodic leg movements are not more prevalent in insomnia or hypersomnia but are specifically associated with sleep disorders involving a dopamineergic mechanism

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The article, thoroughly written by Montplaisir et al. [1], drew attention to the 'specific' dopaminergic (DE) impairment in sleep disorders associated with periodic leg movements (PLMs) and suggested that "some DE system other than the nigrostriatal system may be involved". Our comments emphasize the impairment of spinal DE network [2], which may play a role in restless leg syndrome (RLS) [3], in Parkinson's disease, in the beneficial effects of DE treatment and in the side-effect of neuroleptics [4]. We also cast a shadow of doubt on the specificity of DE involvement.

The spinal mechanism underlying PLM was first demonstrated in dogs by Orbeli and Kunzman [5]. After a unilateral surgical cut of the dorsal roots (L4–S3), the rhythmical movements of deafferented hind limb persisted during drowsiness for many months and often coincided with each breath. PLM, frequently found in patients with spinal cord and peripheral nerve injuries, exhibit the same pattern. Some of these patients respond favorably to L-DOPA treatment. Enhanced spinal cord excitability, loss of sensory input, or supraspinal inhibitory influences in RLS and PLM were meticulously reviewed recently [3,6], and the role of impaired DE control was also suggested.

Apparently, muscular relaxation and limited sensory input in sleep and drowsiness create some spinal deafferentation, even in the absence of abnormalities. This condition becomes exaggerated in the presence of the above-mentioned neuronal impairments, which may be accompanied by a deficit of DE inhibitory control of motoneurons. As in Orbeli and Kunzman's observation, and according to Cannon's law [7,8], the deafferentation of spinal neurons insures their hypersensitivity to any stimuli entering the spinal cord through the remaining pathways. Hence, PLM are known to be escorted by K-complexes and cyclic alternating patterns on EEG, and are often triggered by internal or environmental stimuli. Almost all PLM coincide with the inhalation phase of breathing [9] and occur frequently in the presence of upper airway obstruction as mentioned [1].

Our preliminary data show that the pattern of PLM

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fits a non-linear model of oscillations in which the spinal generation of PLM can be visualized as a pendulum driven by respiratory effort and damped by DE inhibition. This condition may be secondary in some diseases or injuries, and the effect of DE agents may be inhibitory to PLM regardless of a preexisting DE deficit. The DE system is involved in the pathophysiology of PLM, not only in mesolimbic and nigrostriatal structures, but also dopamine-containing neurons in the spinal cord.

The diencephalospinal DE system must be a target of further research, and the forgotten model of Orbeli and Kunzman [5] can be instrumental in this investigation.

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