

# Heart Rate and Spectral EEG Changes Accompanying Periodic and Isolated Leg Movements During Sleep

Commentary on Guggisberg et al. The significance of the sympathetic nervous system in the pathophysiology of periodic leg movements in sleep. *Sleep* 2007;30:755-66

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IN THE JUNE 2007 ISSUE OF *SLEEP*, GUGGISBERG ET AL<sup>1</sup> REPORTED THAT HEART-RATE CHANGES ASSOCIATED WITH SLEEP-RELATED LEG MOVEMENTS PRECEDE both the leg movements and the associated electroencephalogram (EEG) changes by as much as 6 seconds. They also reported that the heart-rate changes were greater when occurring with periodic leg movements in sleep (PLMS) than with either isolated (ILMS) or respiratory-related leg movements. We<sup>2</sup> and others<sup>3</sup> have previously reported essentially opposite findings, i.e., that heart-rate changes associated with ILMS are greater than those with PLMS. In our study, the spectral EEG changes were also greater for ILMS than for PLMS. This discrepancy in leg movement-related heart-rate changes was not addressed by Guggisberg et al.<sup>1</sup> Careful consideration of the 2 works reveals methodologic differences that might account for these discrepancies. In our previous study,<sup>2</sup> we analyzed only PLMS that were separated by at least 30 seconds, as opposed to the 10 seconds used by Guggisberg et al.<sup>1</sup> Our selection of 30 seconds was derived from a preliminary analysis that revealed that leg movement-related heart-rate changes usually persist up to 15 seconds after the onset of the movement. Our choice of a minimum interval of 30 seconds comfortably avoided the potential confounding effects of persisting heart-rate changes from a leg movement preceding the one under analysis. Our heart-rate analyses, extended from 20 seconds before to 30 seconds after each leg movement, with the first 10 seconds used as baseline. This allowed us to be comfortable that the baseline heart rate was not affected by a recent leg movement. Guggisberg et al<sup>1</sup> included PLMS separated by only 10 seconds in their analysis, and their baseline heart rate was therefore determined by a period that was within 10 seconds of the prior movement and would likely include the relative bradycardia occurring after the prior movement. This methodologic problem negatively impacts their results in 2 important ways. First, the simple return to baseline from the natural bradycardia that follows a

preceding leg movement has been misinterpreted as part of an increase in heart rate associated with the subsequent leg movement. Second, this artifactual difference would occur for frequent PLMS spaced closely together but not for ILMS that are spaced, by definition, further apart. As an example, the Figure depicts the heart-rate changes accompanying 2 consecutive leg movements during sleep, separated by approximately 15 seconds, the first of which is not preceded by another leg movement; in this example, it is clear that heart-rate values preceding the second leg movement are significantly lower than the stable baseline values preceding the first leg movement. Such a methodologic problem, if carried through the entire analysis, leads to a misinterpretation of the results. This provides a parsimonious explanation for the discrepancies between this study and the results of previous reports in the literature.<sup>2,3</sup>

Guggisberg et al<sup>1</sup> also did not control for 3 other factors affecting leg movement-related heart rate and EEG changes: first, bilateral PLMS or ILMS have been reported to be accompanied by larger heart-rate and EEG changes than those occurring unilaterally.<sup>2</sup> Guggisberg et al<sup>1</sup> did not specify how many of the PLMS and ILMS were unilateral or bilateral, and different proportions would alter their results. Second, sleep stages, particularly rapid eye movement versus non-rapid eye movement, are associated with differing degrees of leg movement-related heart-rate changes.<sup>2,4</sup> The proportion of ILMS or PLMS occurring in each sleep stage needs to be considered. Finally, the presence or absence of leg movement-related arousal is an important factor that significantly impacts heart rate and spectral EEG.<sup>5</sup> Unfortunately these 3 well-documented factors affecting leg movement-related heart-rate changes were not evaluated in the data presented by Guggisberg et al,<sup>1</sup> further complicating evaluating their results.

The study of the clinical and biologic aspects of PLMS has recently benefited from the development of analytic methods that provide enhanced measurements of their patterns.<sup>6</sup> Moreover, the recent report<sup>7</sup> of an association of PLMS with a specific gene on chromosome 6 further supports the potential biologic significance of PLMS. But neither a genetic association nor enhanced measurement establishes biologic or clinical significance. This requires careful evaluation of both the PLMS and of the physiology and biology associated with them. Advancing the evaluation of PLMS therefore particularly requires, in future investigations, consideration of the methodologic concerns presented above regarding the study reported by Guggisberg et al.<sup>1</sup>

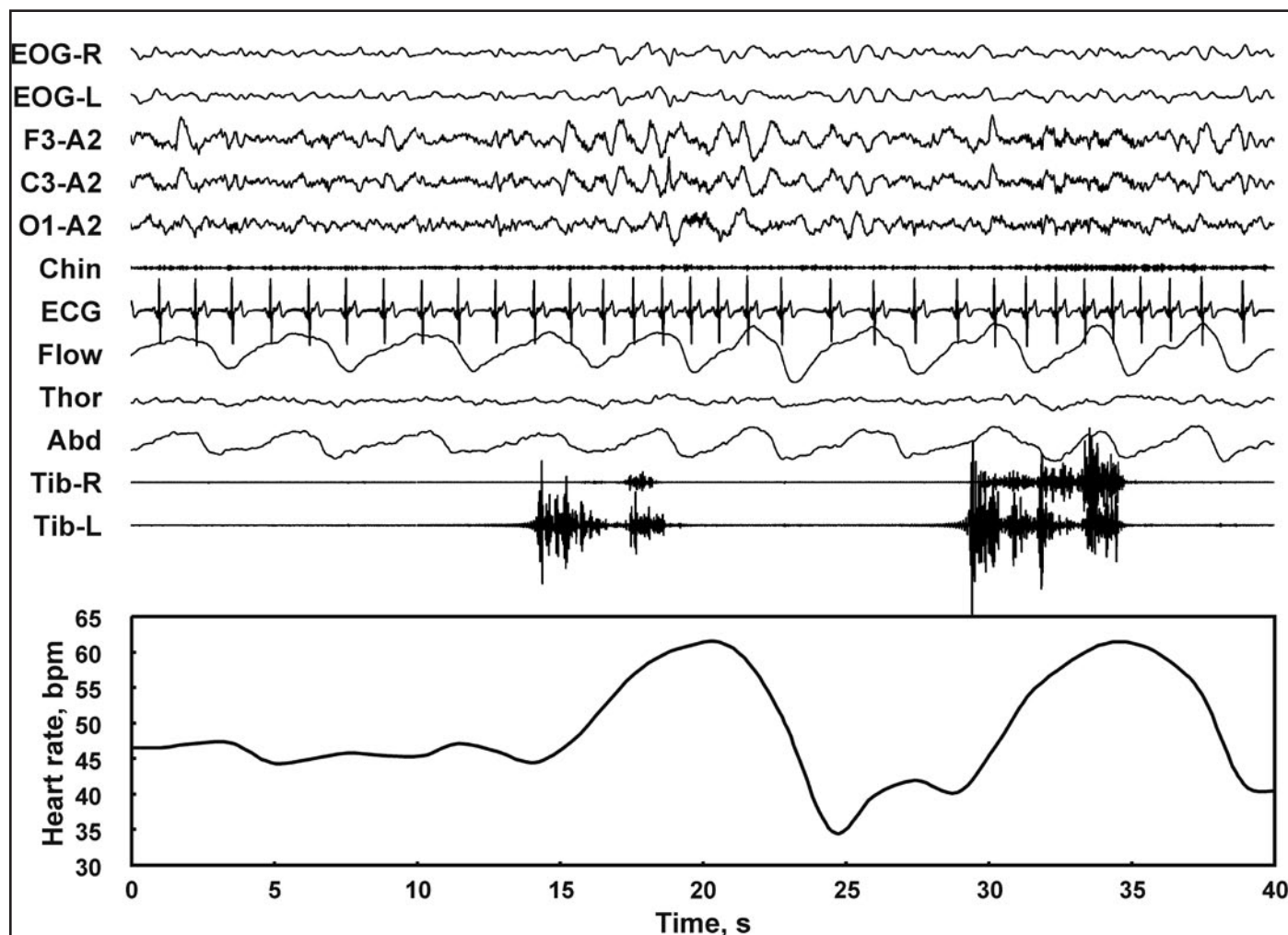
## Disclosure Statement

The authors have indicated no financial conflicts of interest.

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**Figure 1**—Heart rate changes accompanying 2 consecutive leg movements during sleep showing the difficulty in setting reliable baseline values for movements occurring shortly after a previous movement. EOG refers to electrooculogram; ECG, electrocardiogram; Tib, tibialis.

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