Periodic Limb Movements and Heart Rate Changes

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Periodic limb movements (PLM) during sleep are believed to be under the control of the sympathetic nervous system and may cause interrupted sleep and daytime sleepiness. The present case highlights the close relationship between PLM and significant heart rate changes independent of the presence of arousals. Thus, in addition to the already known del-

eterious effect on sleep continuity, moderate-severe PLM may also affect cardiovascular health.

Keywords: Periodic limb movement (PLM), heart rate (HR), sympathetic nervous system (SNS), arousals

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Periodic leg movements (PLM) are movements of the lower limbs occurring during sleep in a periodic fashion every 20-40 s.¹ The presence of a microarousals occurring simultaneously, before or after the onset of this motor event, is a common finding.² The transient increase in heart rate (HR)³ concomitant with these PLM-related arousal events is frequently observed in patients with and without sleep disorders.

REPORT OF CASE

A 67-year-old woman was referred to our sleep disorders unit, with complains of snoring and suspected obstructive sleep apnea. Although she was not aware of breathing pauses during sleep, she reported that her sleep was interrupted by unexplained awakenings. She had a subjective feeling of daytime sleepiness as was apparent from the Epworth Sleepiness Scale (ESS) score of 17 from a maximum of 24. She described a tendency to fall asleep easily in different passive situations. Symptoms of restless legs syndrome (RLS) were not present.⁴ She reported retiring to bed at 22:00 and waking up at 06:00. Her body mass index (BMI) was 37. The results of her polysomnographic evaluation revealed an apnea-hypopnea index (AHI) of 8.9, showing mainly hypopneas related to REM sleep (REM AHI = 23.0; NREM AHI = 6.1). Esophageal pressure was not recorded, and scoring of respiratory effort-related arousals (RERAs) was not performed since airflow was recorded by a thermistor, which is not a reliable sensor for the measurement of RERAs.

She slept during the whole night on her back and snored continuously, with a maximum loudness of 69 dB. Continuous PLM were recorded only during the first third of the night and were scored according to standard criteria.⁵ Non-PLM were not recorded. There were 199 periodic leg movements, of which 136 (68.3%) were associated with EEG arousals. The PLM index was 28.6, and the PLM arousal index was 19.6. Although not all leg movements were associated with arousals, it was remarkable that continuous brady/tachycardia (between 50-75 bpm, compared to a baseline about 53-55 bpm) was recorded in concomitant with the periodic leg movements (**Figure 1**).

DISCUSSION

The present case highlights the close relationship between PLM and significant heart rate changes independent of the presence of arousals. A number of studies have demonstrated a temporal relation between PLM and HR changes. However, a variable portion of these electrocardiographic events were accompanied by cortical arousal. In one study of 8 PLM patients, it was found that HR changes associated with PLM occur whether or not there is an accompanying EEG arousal.⁶ The HR began to increase 3 cardiac cycles before the onset of PLM and peaked at 4 cardiac cycles after the onset of PLM. Sforza et al.³ found that PLM were associated with visible EEG microarousals lasting longer than 3 seconds in one-third of all PLM. These previous observations are in concordance with our findings. In the present case, a remarkable and continuous brady/tachycardia changes in parallel with PLM events not always associated with an EEG arousal pattern was evident. Since we did not score RERAs, it is theoretically possible that slight variations in airway resistance were associated with PLM related HR changes. Nevertheless, since prominent HR changes occurred only during the period where PLM were present, it is unlikely that the described HR pattern is related to a breathing abnormality.

Recently, it was shown that in patients with PLM during sleep, a periodic sympathetic activation underlying the increase in HR occurred synchronously with the rise in the EEG delta activity just before the onset of the motor event.^{7,8} This was followed by an increase in fast EEG activity and HR whether or not the PLM was associated with arousals. This chain of events is most probably under the general control of a common mechanism, i.e., "the cyclic alternating pattern," which has been shown to have a gating control function on the generation of PLM.^{9,10} The recently reported association of incident cardiovascular disease with PLM during sleep in a large cohort of community dwelling elderly men living in the US,¹¹ and the increased mortality risk in patients with systolic heart failure and PLMI ≥ 5 ,¹² emphasize the need for further studies addressing the possible mechanisms by which PLM could be involved in the pathogenesis of cardiovascular disorders.

Figure 1—Sleep Disorder Unit - Loewenstein Hospital

Note the continuous and prominent brady/tachycardia changes concomitant with period limb movements (PLM) during sleep. This compressed view of the HR changes across night allows a simple and rapid visualization of this typical HR pattern which accompanied the PLM activity during sleep. This patient also showed REM-related breathing abnormalities and continuous snoring while sleeping in the supine posture during the whole night. The amplified area, illustrates a 3-min epoch showing a sequence of PLM events as part of the period in which prominent HR changes were observed in parallel with the occurrence of PLM events. (RAT, right anterior tibialis; LAT, left anterior tibialis).

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