Peripheral vasoconstriction during REM sleep detected by a new plethysmographic method

To the editor—Rapid-eye-movement (REM) sleep is associated with more sympathetic activation than is NONREM sleep[1,2]. So far, there are no data regarding vascular tone during REM and NONREM sleep in humans. Using a new plethysmographic technique to measure peripheral arterial tone (PAT), we report here that REM sleep in humans is associated with considerable peripheral vasoconstriction. The apparatus is essentially a plethysmograph that, unlike models now available, is able to envelop the finger up to and beyond its tip with a uniform pressure field. The applied pressure field is sufficient to substantially unload arterial wall tension, thereby improving the dynamic range of the system, while preventing the potential occurrence of venous engorgement that promotes vasoconstriction. Pressure within the probe originates from a pressurized balloon located over its outside wall. Pulsatile volume signals were recorded as optical density changes from the finger's palmar surface within the applied pressure field. The device was tolerated well for extended periods.

We measured pulsatile finger blood flow throughout the night in 9 normal young adults (25–40 years of age) and 17 patients with light-to-moderate sleep apnea syndrome (35–60 years of age; mean respiratory disturbance index, less than 30). The PAT signals were analyzed by a dedicated computer program in terms of mean relative peak to peak amplitude in 1-minute 'bins' for the first and second REM periods, and for 20 minutes of NONREM periods before and after each REM period. PAT amplitudes were expressed as percentages of the mean amplitude during the initial 5 minutes of the NONREM period preceding each REM period. Minutes with body movements were omitted before analysis. In both groups, REM sleep was associated with considerable attenuation of the PAT signal (Fig. 1). The decrease in amplitude began during NONREM sleep and reached a nadir during REM sleep. As there were neither differences between groups nor differences between the first and second REM periods, we pooled data and analyzed these by repeated measures ANOVA . The percent change during REM sleep (–16.3 ± 19.7%) was significantly higher than that during NONREM sleep before (–3.39 ± 14%) or after (–2.39 ± 27.2%) REM sleep ($P < 0.009$). The curves describing the change in amplitudes during the transition from NONREM to REM and back to NONREM sleep could be fitted with a quadratic trend ($P < 0.02$) with a minimum occurring 8.5 minutes after the start of REM sleep.

The intense sympathetic activation during REM sleep and the preponderance of REM in the early morning hours have led to the suggestion that REM sleep may be responsible for increased cardiac events seen at this time[3]. Although we have no data to show that REM-related vasoconstriction also occurs in larger blood vessels or is specific to the periphery, the report that in a canine model, experimental occlusion of the coronary arteries during REM sleep results in a greater than expected decrease in coronary blood flow[4] indicates that REM-related vasoconstriction may predispose patients with compromised coronary arteries to ischemic events during sleep[5].

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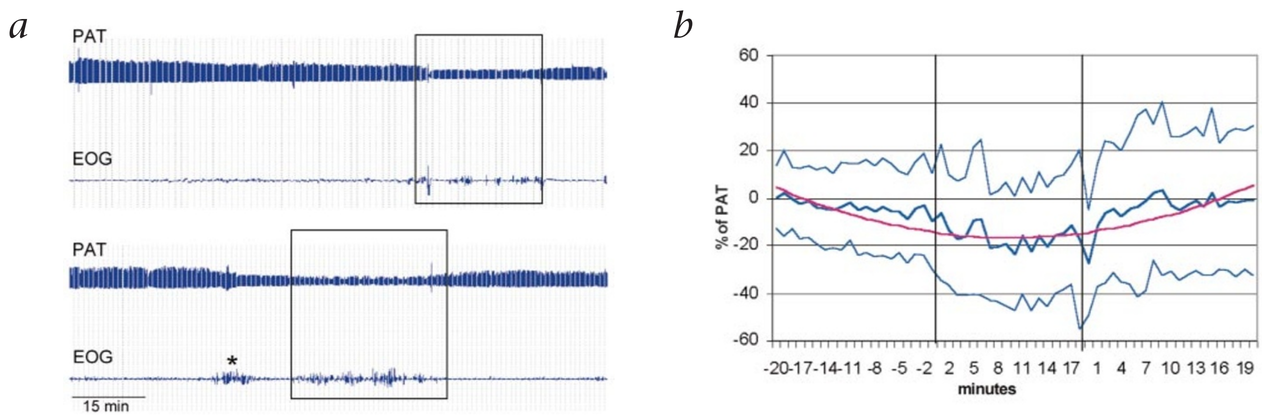

Fig. 1 Peripheral vasoconstruction during REM sleep. ***a***, Compressed records of the PAT signal and electro-oculogram (EOG) during the transition from NONREM to REM and back to NONREM sleep, in two subjects. The EOG records help identify the times of the traditionally scored REM periods. The gradual decrease in PAT amplitude starts at least 30 min before the beginning of the traditionally scored REM sleep. *, Body movements artifact. ***b***, Mean percent change (± s.e.m.) in PAT amplitude, referenced to the mean amplitude in the initial 5 minutes of the preceding NONREM period, averaged across all 54 REM periods. The curve describing the NONREM–REM transition is synchronized to the first minute of REM sleep (vertical line). The curve for succeeding NONREM periods is synchronized to the first NONREM minute (vertical line). As REM periods varied in length, the percent change during REM sleep were calculated only when there were at least five data points. Red line, quadratic trend fitted to the data.