The effect of sleep position on the diagnosis of obstructive sleep apnea: a word of caution

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■ Sleeping in the supine position exacerbates obstructive sleep apnea. Patients sleeping *off* their backs during a polysomnographic study might have a normal study in spite of having a history of severe obstructive sleep apnea. This might be shown by repeating the study with the patients spending most of the study time sleeping *on* their backs. We report three patients illustrating this point and discuss the importance of monitoring sleep position while performing polysomnography. The effect of position in interpreting different therapeutic modes for obstructive sleep apnea should be considered.

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SLEEPING ON THE BACK is known to exacerbate obstructive sleep apnea (OSA).[1–4] On the other hand, some reports have pointed out the ameliorating effect that the side (or "non-back") position has on OSA and recommend that patients adopt this position as one of the therapeutic modalities for sleep apnea.[5–7]

■ *See Commentary, p. 636*

Given these observations, we hypothesized that sleep position also may have a crucial influence on the results of routine polysomnography (PSG). To test this, in 1988 we developed a position monitor[8] to facilitate the accurate account of position changes during sleep. The position monitor is a transducer operated by two mercury switches contained in a small device attached to the patient's chest (*Figure*). Position is recorded as either back (up to 45° of rotation to either side of the vertical, in the supine position) or non-back. The two positions are continuously displayed on one channel of the PSG monitor, as distinct, different pen deflections.

Our 4-year experience with the sleep position monitor has led to the observation that PSG performed in the non-back position may yield normal results despite a history of severe OSA confirmed by repeat PSG performed during sleep in the back position. We present three cases from our sleep laboratory that illustrate this point. To the best of our knowledge, this has not previously been reported.

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CASE HISTORIES

Case 1

A 46-year-old moderately obese female (155 cm, 88 kg, 60% overweight) presented with excessive daytime somnolence for the past 6 years. Her sleep was characterized by frequent arousals and mild snoring. Her his-

tory was negative for cataplexy, sleep paralysis, and hypnogogic hallucinations. A sleep study performed at another center was positive for OSA with an apnea index of 20 (number of episodes per hour of sleep). Because oxygen saturation was not measured in that study, we repeated the PSG in our sleep laboratory. The presence of hypoxia during the apneic episodes adds information documenting the severity of sleep apnea and has possible implications on the pathophysiology of cardiovascular complications of this condition. During the first study in our lab, the patient spent all night *off* her back and had only three episodes of apnea (apnea index 0.6). An additional study was performed. This time the patient spent 77% of the time *on* her back, during which 89 apneic episodes were recorded, for an apnea index 16.8 (mild severity). No significant oxygen desaturation was demonstrated during the apneic episodes.

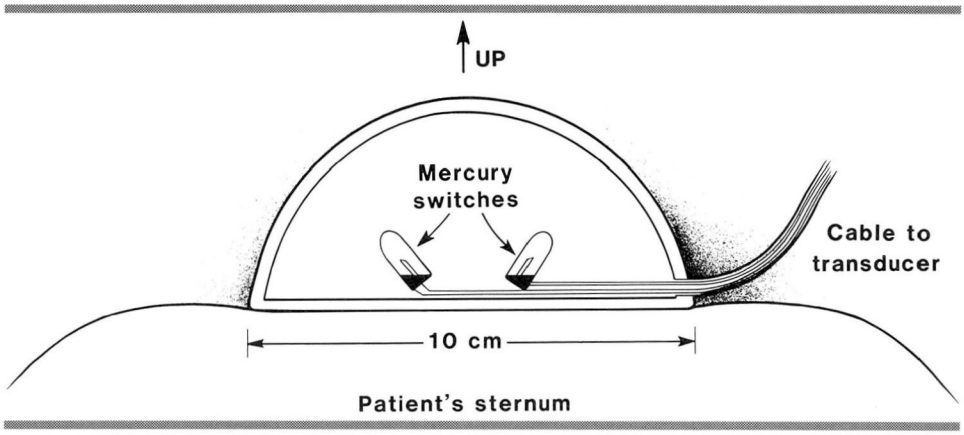

FIGURE. A schematic cross-section of a position monitor. The mercury creates an electrical contact between the central pin and the base of the switch capsule, which are otherwise isolated. Both switches are "turned on" simultaneously in the back position and close an electrical circuit. When the patient turns more than 45° to either side, the mercury in one of the switches leaves the base of the capsule, and the circuit is interrupted.

Case 2

A 53-year-old mildly obese male (176 cm, 92 kg, 21% overweight) presented with a 10-year history of snoring, episodes of sleep apnea, snorting, frequent arousals, morning headaches, and excessive daytime sleepiness. During his first polysomnogram, he spent 22.2% of sleep time on his back and had 30 episodes of apnea, for an apnea index of 5.0 (upper limit of normal). During a repeat study he spent 100% on his back and had 372 episodes of apnea, for an index of 72.6 (severe sleep apnea). No significant oxygen desaturation accompanied the apneic episodes.

Case 3

A 47-year-old mildly obese male (182 cm, 99 kg, 20% overweight) presented with the complaints of snoring, sleep apneas, snorting, frequent arousals, and excessive daytime sleepiness for a few years. During his first polysomnogram, he spent 16.6% of the study on his back, having only six episodes of apnea, for an index of 1.5 (normal). During repeat PSG, the patient spent 99.7% on his back, having 195 episodes of apnea, for an index of 30.5 (moderate severity). Again, no significant oxygen desaturation accompanied the occurrence of apnea.

DISCUSSION

Position monitoring during polysomnography is of great importance in patients with OSA due to the marked influence that position might have on the occurrence of episodes of sleep apnea. As seen in one of our patients, severe OSA (apnea index >70) may be classified as a borderline normal study (an index of 5) if studied *off* the back.

In his National Cooperative Study, Coleman[9] reported that the "most common parasomnia was the newly created category, parasomnia complaint without objective findings. This category consists of patients who presented complaints of difficulty breathing, snoring, swallowing, chewing, or seizures associated with sleep. In many cases, the patient, bedmate, or referring physician suspected sleep apnea on the basis of presenting symptoms." It is possible that some of these patients indeed suffered from OSA but failed to yield abnormal study results because of their sleep position, sleeping *off* their backs. No reference was made to sleep position in the National Cooperative Study, and we suspect that sleep position was not quantified before 1980 in most centers. Rejecting the diagnosis of sleep apnea following a single polysomnogram, when position is not monitored, might be misleading.

Body position must be of utmost concern in evaluat-

ing the effect of various therapeutic modalities, such as medications, weight loss, continuous positive airway pressure, and surgery (uvulopalatopharyngoplasty), and follow-up studies should be controlled for position. Monitoring sleep position is also important in epidemiologic studies concerning OSA. The percentage of time spent sleeping on the back varies in a given patient from night to night and might range from 0% to 100%. The most severe OSA occurs in the majority of patients when they sleep *all* night *on* their backs. When performing polysomnography, we want to find out how severe the sleep apnea can become and preferably study our patients while they are sleeping only on their backs. However, since this is not always possible, we feel that polysomnographic studies for OSA should be performed while the patients spend at least 50% of their total sleep time in the back position. It would be beneficial to calculate separately the back apnea index (total number of apneic episodes on the back, divided by total back sleep time in hours): in most cases, this index is higher and gives a better estimation of the possible severity of the OSA syndrome. The variability between different night studies in a given patient regarding other aspects of sleep has been reported as well[10] and should perhaps necessitate the performance of two separate night studies in each patient, even if an adequate percentage of sleep time is spent on the back during a single study.

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Commentary

Sleep apnea syndrome (SAS) exists as a primary cause of daytime sleepiness. The past decade has seen a logarithmic increase in the number of studies on sleep apnea with a concomitant increase in awareness of SAS by the practicing physician. Several studies suggest SAS is associated with increased morbidity and mortality in addition to its adverse impact on social relationships and the activities of daily living. He and colleagues (Chest 1988; 94:9) reported a significantly higher mortality rate in untreated sleep apnea patients with an apnea index greater than 20 as compared with those with an index less than 20. The probability of cumulative 8-year survival was .96 ± 0.02 in the group with an apnea index less than 20 as compared with .63 ± .17 for those with an index greater than 20. The difference was most pronounced in those under age 50. The availability of an effective viable treatment option (nasal continuous positive airway pressure) for a potentially fatal disease increases the importance of a reliable diagnostic test.

Overnight polysomnography is the preferred diagnostic modality. However, the negative predictive value of this test is unknown. Previous authors have reported a significant night-to-night variability in apnea index, particularly in those with milder forms of the syndrome (Wittig et al. Amer Rev Resp Dis 1984; 129:224). Katz and Dinner underscore the importance of body position as an additional variable. Failure of the patient to sleep on his back may result in a false-negative test. They argue persuasively for inclusion of position monitoring in routine clinical polysomnography. In the absence of position monitoring, a repeat study should be considered if the clinical suspicion of SAS remains high and the initial study is negative.

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