

How Reliable is the Diagnosis of Positional Obstructive Sleep Apnea?

Helen S. Driver*, Farzad Saberi, Neela Chatha, Alison M. Urton, Peter Munt and Michael F. Fitzpatrick

Abstract

Objectives: To examine the reliability of a diagnosis of positional obstructive sleep apnea (OSA), with an apnea hypopnea index (AHI) for lateral sleep less than half the supine AHI (S-AHI) and less than 15 per hour, in patients using positional therapy for a full night.

Methods: Prospective follow-up polysomnography after a median of 5.5 months (range 1-36.5) on 32 patients (21 male 11 female), mean age 55, range 23-81 years, mean BMI 28, range 22-37 kg/m² found to have positional OSA on a diagnostic study. Patients were prescribed positional therapy (asked to sleep on their side).

Results: On the diagnostic study, the (mean±SD) S-AHI was 32.1±17.6/hr versus 4.5±3.5/hr when lateral (L-AHI). On follow-up, lateral sleep time increased from 54±25% (range 0-98) to 92±13% (range 47-100, p<0.01); total sleep time (TST) was significantly shorter from 362±70 min to 303±79 mins (p<0.01), while REM sleep time was similar. The L-AHI on follow-up was higher at 7.4±6.5/hr than on the diagnostic study (p=0.015), but only five patients (16%) had a L-AHI greater than 15/hr. On the follow-up night, four patients were split to CPAP therapy - one due to the L-AHI being above 20 per hour, and three due to dissatisfaction and/or discomfort with long-term positional therapy. For an increase in lateral sleep time by 38±27%, the corresponding increase in L-AHI was 2.9±6.4/hr.

Conclusion: Using a cut-off L-AHI at 15/hr, a diagnosis of positional OSA remains valid in the majority of patients at repeat overnight polysomnography with more lateral sleep time.

Introduction

In the majority of patients with obstructive sleep apnea (OSA) the disease severity changes with posture, usually becoming more severe while in the supine position and less severe when the head is elevated or the patient sleeps in the lateral position.^{1,2} For most patients this postural change is not of great therapeutic significance because OSA persists when they sleep

on their side. However, for a minority of patients the postural difference is very significant because the disease may not manifest in the lateral sleeping position. The diagnosis of postural OSA is made when the apnea hypopnea index (AHI) in the supine position is at least twice that in the lateral position.^{1,3} Others have employed more stringent criteria for the diagnosis of positional OSA by adding an additional criterion - that the AHI in the lateral position (L-AHI) fall in the "mild" range (AASM 1999)⁴ and be less than 15 per hour.⁵

For patients with positional OSA, positional therapy - using some simple behavioral treatment modalities to prevent them from sleeping on their backs, such as a backpack and ball (See Table 1), has been shown to be effective in reducing the AHI.^{3,5} Patients with positional OSA tend to be younger and thinner with fewer and less severe breathing abnormalities than "non-positional" patients.^{2,6} The option for positional therapy, as opposed to continuous positive airway pressure (CPAP), is a viable one^{3,5} and, for many patients with positional OSA, this simple treatment may be more desirable, at least in the short term. However, the reliability of the diagnosis of positional OSA⁷ depends on the duration of sleep and the sleep stages encountered during the diagnostic polysomnogram, and that duration can often be quite brief. Indeed, it may be difficult to gauge from a short time window in the lateral position the true severity of OSA in that position during a full night's sleep. The validity of a diagnosis of positional OSA on diagnostic polysomnography including sleep in the supine and lateral positions has not been established during follow-up polysomnography with positional therapy employed.

Methods

Thirty-two consecutive patients who were found to have positional OSA with the L-AHI that was less than half the supine AHI (S-AHI) and with the L-AHI less than 15 per hr^{3,5} were invited to return to the sleep laboratory for a follow-up study. These patients were prescribed positional therapy and asked to sleep on their side. They were all provided with education about OSA and positional therapy including suggestions for making home-made positional therapy devices in order to stay on their sides while they slept (Table 1).

Prospective follow-up polysomnography was conducted after a median of 5.5 months (range 1-36.5 months) on the 32 patients (mean ± SD) aged 55 ± 14 years, range 23-81 years, body mass index (BMI) of 27.6 ± 2.6 kg/m², range 22-37 kg/m². The 11 women and 21 men (Age: women, 56 ± 10 years; men,

Sleep Disorders Laboratory, Kingston General Hospital and Department of Medicine, Queen's University, Kingston, Ontario, Canada.

Helen Driver, PhD, RPSGT, D.ABSM, Sleep Disorders Laboratory Room 20-303, Richardson House, 102 Stuart Street, Kingston, Ontario K7L 2V6, Canada, Tel: +613-548-6052, Fax: +613-549-1459, Email: driverh@kgh.kari.net

Table 1. Strategies to Help Prevent Patients From Sleeping Supine

- 1) Sew or attach a sock, filled with hard balls or a large round object of wood or other material, length-wise down the back of your pajama top or nightshirt. This makes it uncomfortable to lie on your back and you will usually move onto your side.
- 2) A knapsack, belt pouch filled with a round piece of wood or other hard material that will prevent you from rolling on to your back can be substituted for the sock filled with tennis balls if it is not working to keep you sleeping on your side.
- 3) Another technique is to use positional pillows to assist in sleeping on the side.

54 ± 16 years; and BMI: women, 28.9 ± 4.5 kg/m²; men 27.6 ± 2.6 kg/m²) were requested to sleep in the lateral position only.

All patients completed the Epworth sleepiness scale (ESS) in the evening before each study.⁸ Routine polysomnography included sixteen channels: Four EEG electroencephalogram channels (C4-A1, C3-A2, O2-A1, O1-A2), two electrooculogram (EOG) channels (ROC-A1, LOC-A2), chin electromyogram (EMG), two airflow measurements - one using a nasal cannula pressure transducer (Ultima Pressure Sensor, Braebon, Carp ON, Canada) the other a thermocouple (nasal and oral), intercostal EMG, electrocardiogram (ECG), chest and abdominal movement (piezo belts), finger pulse oximetry (Nellcor pulse oximeter -N200, Tyco Healthcare), anterior tibialis EMG, and a vibration snore sensor. The polysomnographic data were digitized and recorded on a computerized polygraph (Sandman software; Tyco [Mallinckrodt /Nellcor Puritan Bennett (Melville) Ltd.] Ottawa, Canada).

A video camera mounted on the wall of the bedroom was used to monitor the patient and observe body position. A registered polysomnographic technologist (RPSGT) responsible for monitoring two patients annotated changes in body position in the digital polysomnogram.

The sleep records were scored in 30 second epochs according to standardized criteria.⁹ Obstructive apneas/hypopneas were scored using standard criteria.⁴ Events were scored when a >50% decrease (apnea) in airflow, or clear reduction (hypopnea) in amplitude of the airflow signal (compared to stable breathing during the 2 minutes preceding the event) occurred associated with an arousal and/or a greater than 3% reduction in oxygen saturation (SaO₂), and the event lasted for at least 10 seconds. Arousals were scored based on ASDA criteria.¹⁰ The AHI for body position was calculated from the total number of apneas and hypopneas according to time asleep and by body position to give the number of events per hour of sleep for supine and lateral sleep time.

A paired t-test was used to compare the lateral and supine AHI of each patient's diagnostic study to his or her therapeutic study. The recorded AHI from the second study was then compared to that of the first study to determine whether or not positional therapy had been effectively and reliably controlling the patient's OSA.

Results

On the diagnostic study, the AHI (mean ± SD) when supine (S-AHI) was significantly higher at 32.1 ± 17.6 per hour versus 4.5 ± 3.5 per hour when lateral (*p* = 0.00) (Figure 1). During the diagnostic study, patients slept in the lateral position for

54 ± 25% (range 0-98%, median 59) of the time (196 ± 99 minutes). Two patients who did not have any lateral sleep on the diagnostic study were included in the analysis with the reported L-AHI at 0 per hour. On the follow-up study for these two patients, one with S-AHI of 47 on the diagnostic study had a L-AHI of 20 per hour of follow-up, whereas the other with S-AHI of 17 had a L-AHI of 6 per hour.

On follow-up all but two of the patients increased the time that they slept on their side 92 ± 13% (range 47-100%, median 100, *p* < 0.01) (280 ± 86 minutes). The two patients with less lateral time on the follow-up study both spent more than 80% of the sleep time on their side on both nights. Their L-AHI on the two nights was less than 15 - for one patient the L-AHI was 13.5 for 98% sleep time in the lateral position and on follow-up 10.3 for 89% lateral sleep time; the other was 1.5 for 89% then 2.5 for 83% lateral sleep time. Eighteen patients slept exclusively on their side. The total sleep time (TST) was significantly shorter on follow-up from 362 ± 70 minutes to 303 ± 79 minutes (*p* < 0.01) but the time spent in REM sleep (median, range) was similar (Diagnostic: 64 minutes, range 12-120 minutes; Follow-up: 56 minutes, range 0-126 minutes; *p* = 0.34) being 17.9 ± 6.0% and 17.7 ± 8.6% of the TST respectively (*p* = 0.87).

The L-AHI on follow-up was significantly higher at 7.4 ± 6.5 per hour (range 0.2-23) than 4.5 ± 3.5 (range 0.0-13.5) on the diagnostic study (*p* = 0.015). For a 1.4 increase in lateral sleep time (by 38 ± 27%, 84 minutes), the corresponding increase in L-AHI was 2.9 ± 6.4 per hour. Individual AHIs during lateral sleep time for the diagnostic and the follow-up studies are shown in Figure 2; only 4 patients had an increase in the L-AHI by more than 10 per hour. On follow-up, thirteen patients (41%) had a L-AHI below 5 per hour, but five patients (16%), three of whom were women, had a L-AHI greater than 15 per hour. Furthermore, on the follow-up night, four of the patients (3 women) were split to CPAP therapy - one was due to the lateral AHI being above 20 per hour,¹¹ the other three were due to discomfort and/or dissatisfaction with long-term positional therapy. Of the 11 women, 8 had a L-AHI > 5 on follow-up (73%) compared with 3 on the diagnostic study (27%), whereas 12 of 21 men had a follow-up L-AHI > 5 (57%) versus 8 on the diagnostic study (38%).

In twenty patients for whom follow-up weights were available, the BMI showed a trend to increase by 1.3 (-1.4 to 2.6 kg/m²) from diagnosis to follow-up (*p* = 0.1) with a correlation between the L-AHI and BMI on the follow-up study (*r* = 0.42, *p* < 0.02). There was a trend towards an improvement in daytime sleepiness with lower ESS on follow-up at 8 ± 9 compared with 10 ± 10 on the diagnostic study (*p* = 0.08).

Discussion

We found that a diagnosis of positional OSA on the basis of a single diagnostic sleep study, based on an AHI less than 15 per hour in the lateral sleeping position that was also less than half the supine AHI,^{3,5} is valid in the majority of patients on a follow-up study employing positional therapy to avoid sleeping supine. On follow-up after a median of 6 months, for an increase in lateral sleep time by 38 ± 27% in 32 patients with positional OSA, the corresponding increase in L-AHI was 2.9 ± 6.4. Only four patients had an increase in the L-AHI by more than 10 per hour, one of these patients did not have any sleep while on their side for the diagnostic study. For an accurate diagnosis of positional OSA, there must be at least some

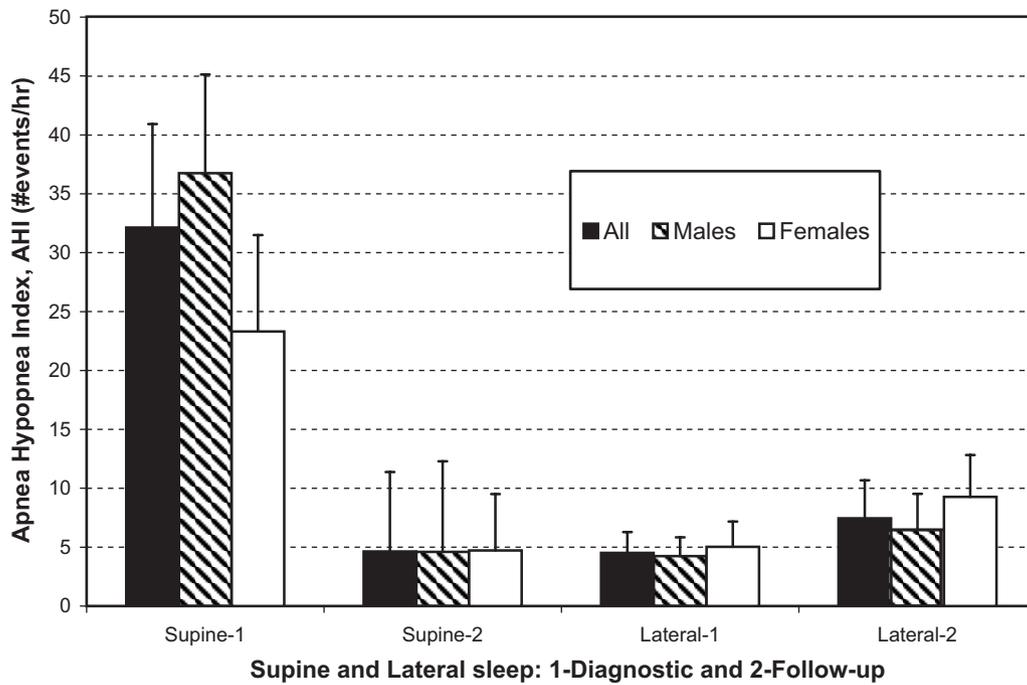


Fig. 1. Apnea hypopnea index (AHI) by gender for supine and lateral sleep on a diagnostic (-1) and a follow-up night (-2) in 11 women and 21 men with positional obstructive sleep apnea (OSA). On the follow-up night patients were using positional therapy to sleep on their side. Values shown are mean \pm SD.

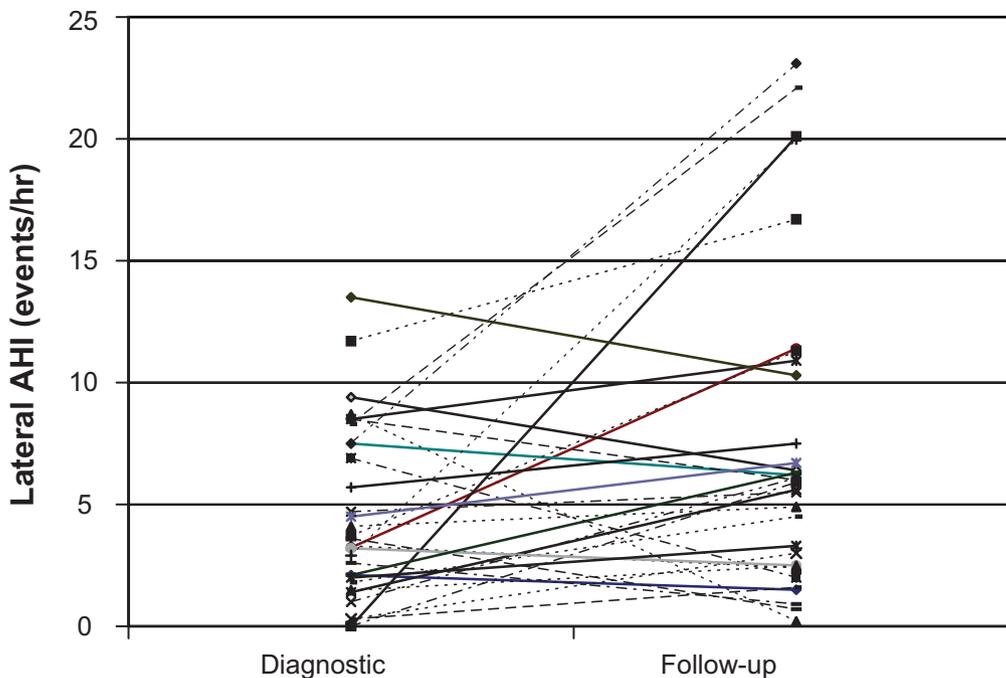


Fig. 2. Individual apnea hypopnea index (AHI) during lateral sleep on a diagnostic and a follow-up night in 32 patients with positional obstructive sleep apnea (OSA) who were avoiding sleeping in the supine position on the follow-up study.

time with lateral sleep on the diagnostic study. Indeed, Jokic *et al.*⁵ have suggested that a minimum duration of 1 hour lateral sleep, including at least one period of REM sleep be required for the diagnosis of positional OSA.

The most common treatment for OSA in symptomatic patients with a minimum AHI of 5 per hr is continuous positive airway pressure (CPAP).^{11,12} CPAP acts as a pneumatic splint to maintain upper airway patency. Although the majority of

all newly diagnosed patients with OSA receive CPAP as the first-line treatment, many refuse this therapy because they find it uncomfortable or cumbersome, or because they are claustrophobic. Other patients, after initially accepting the treatment, are subsequently non-compliant.⁵ Although CPAP has been proven efficacious in the treatment of moderate and severe OSA, its benefit to patients with mild OSA is often marginal.¹³ For patients with mild-moderate OSA, having an AHI of 5 to 15 events per hour and minimal daytime symptoms, who are resistant to CPAP therapy, positional therapy should be considered as a viable treatment option.

The TST for positional analysis on the follow-up night was reduced because four patients were split to CPAP therapy. These patients, mostly women, were not comfortable using positional therapy due to pain or discomfort, especially in the shoulder and knee, from spending the night on their side and were dissatisfied with positional therapy. One patient, with a follow-up study 3 months after the diagnostic study was found to have a L-AHI of 20 per hour and was split to CPAP therapy.

We found a weak positive correlation of L-AHI with BMI. The association of overweight with OSA is well described and has also been reported for positional OSA with a stronger association between the supine AHI and obesity.^{3,6} For a group of 24 patients, Cartwright¹ suggested that those who were close to normal body weight (within 25% of ideal weight) were more likely to benefit from sleeping on their side than the more overweight OSA patients given a reduced AHI on their side compared to sleeping on their backs. Indeed, in a larger sample of OSA patients (n=574), Oksenberg *et al.*⁶ found a higher proportion of positional OSA (68%) in patients with a lower BMI ($\leq 30 \text{ kg/m}^2$) and in those with less severe OSA having a respiratory disturbance index (RDI) $< 40/\text{hr}$ (66%). Furthermore, patients with positional OSA were younger, by 2 years⁶ and 6.7 years,² than the non-positional patients.^{2,6} These data point to the progression of OSA, starting out as mild and positional in younger patients and becoming more severe and non-positional with increased age and weight. Positional therapy has a role as an effective treatment option in patients with mild positional OSA,^{3,5} based on the AHI with the additional recommendation for weight-loss. In addition to sleeping in the lateral position, many patients may benefit from elevation of the head of the bed to 60 degrees.¹⁴ The latter strategy was not tested in the current study because in our experience few patients can tolerate such high degrees of head elevation at night for prolonged periods.

In this study we only considered the AHI, thus snoring - and the inclusion of snore arousals to calculate the RDI - was not included in the analysis. In asymptomatic male snorers, although positional therapy improved the AHI (from 17.5 to 14.1 per hour), it was not effective in reducing snoring.¹⁴ The failure to manage the snoring trauma in the upper airway may result in edema in some patients with confusing results when they return for their second study. Thus snore-related arousals and continuous snoring, regardless of body position, should be taken into account when considering a recommendation of positional therapy. Indeed we titrate CPAP pressure so as to alleviate snoring and arousals as well as the AHI. In addition, the ability to monitor compliance and efficacy using positional therapy at home would be advantageous. A weakness of this study is that we do not have compliance data for home positional therapy.

Conclusion

Although the AHI in the lateral position is variable from night to night in patients with positional OSA, the size of that change is usually quite small even up to 3 years later assuming there is no significant weight gain. A diagnosis of positional OSA at diagnostic polysomnography remains valid in the great majority of patients at repeat overnight polysomnography with more lateral sleep time. In recommending positional therapy the diagnosis of positional OSA should include: (1) At least one hour of lateral sleep, (2) L-AHI less than half the S-AHI, and (3) L-AHI should fall in the mild range (< 15 per hour). Not all patients can tolerate positional therapy in the long term due to discomfort from only sleeping on their side, and, with a gradual progression to worsening OSA becoming non-positional with age and increased weight, CPAP therapy is the standard alternative.

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