Clinical Practice

This Journal *feature begins with a case vignette highlighting a common clinical problem. Evidence supporting various strategies is then presented, followed by a review of formal guidelines, when they exist. The article ends with the author's clinical recommendations.*

Obstructive Sleep Apnea

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A 43-year-old man presents with heavy snoring; his bed partner reports that he sometimes stops breathing while he sleeps. He admits to feeling sleepy at times when he drives, although he has not had any motor vehicle accidents. He has hypertension that is controlled by medication but is otherwise healthy. Physical examination reveals that he is overweight (body-mass index [the weight in kilograms divided by the square of the height in meters], 32.7) and has a large neck circumference (46 cm). How should this patient be evaluated and treated?

The Clinical Problem

Brief periods of breathing cessation (apnea) or a marked reduction in tidal volume (hypopnea) are common in adults during sleep. The obstructive sleep apnea syndrome is defined by an apnea–hypopnea index (the total number of episodes of apnea and hypopnea per hour of sleep) of 5 or higher in association with excessive daytime somnolence. According to these criteria, sleep apnea occurs in 4 percent of men and 2 percent of women who are 30 to 60 years of age. A much higher percentage meet at least one of these criteria: 16 percent of men and 22 percent of women have hypersomnolence, and 24 percent of men and 9 percent of women have an apnea–hypopnea index of at least 5.[1] The index can exceed 100 in patients with very severe cases. Risk factors for sleep apnea include obesity, increased neck circumference, craniofacial abnormalities, hypothyroidism, and acromegaly.

The differential diagnosis includes simple snoring, central sleep apnea, and other disorders that cause daytime sleepiness (e.g., insufficient sleep, a circadian-rhythm abnormality, narcolepsy, and periodic limb movement disorder). Polysomnography, the standard diagnostic test, requires considerable technical expertise and is both labor intensive and time consuming. Because timely access to polysomnography is often a problem, interest in alternative diagnostic approaches, such as the use of clinical prediction rules and portable monitors, has increased. Portable monitors, which record the number of breathing disturbances per hour of monitoring time, are used to calculate the respiratory-disturbance index.

A decision to pursue diagnostic testing and subsequent treatment of sleep apnea takes into account whether such an approach would reduce a patient's risk of death, major cardiovascular or cerebrovascular events, or motor vehicle accidents and whether it would improve the quality of life. Retrospective and cross-sectional studies suggest that sleep apnea is a risk factor for morbidity and mortality from cardiovascular causes[2,3]; however, patients with higher respiratory-disturbance indexes have more cardiovascular risk factors than patients with lower indexes,[4] suggesting that there may not be a causal relation. To date, no prospective cohort studies and no randomized trials have found that successful treatment alters cardiovascular or cerebrovascular outcomes.[5] A longitudinal cohort study drawn from the general population has provided evidence of a causal link between sleep apnea and systemic hypertension[6]; however, so far there is no conclusive evidence that treatment of sleep apnea substantially improves the severity of hypertension or reduces the need for antihypertensive therapy. A study of 210 patients with untreated sleep apnea found a threefold increase in the rate of motor vehicle collisions as compared with the rate in control subjects[7]; the rates fell to control levels with treatment with continuous positive airway pressure.

In the majority of patients without coexisting conditions (e.g., coronary artery disease, heart failure, or respiratory failure), the primary reason to test for and treat sleep apnea is the potential to improve the quality of life. Clinicians do not make decisions about treatment on the basis of the apnea–hypopnea index alone because it correlates poorly with the quality of life and the severity of symptoms[8] and does not help to determine the risk of a motor vehicle collision.[9] Thus, decisions about management are guided by the clinical probability of disease, the severity of daytime symptoms, and the effect of the respiratory disturbance on the quality of life (Fig. 1).

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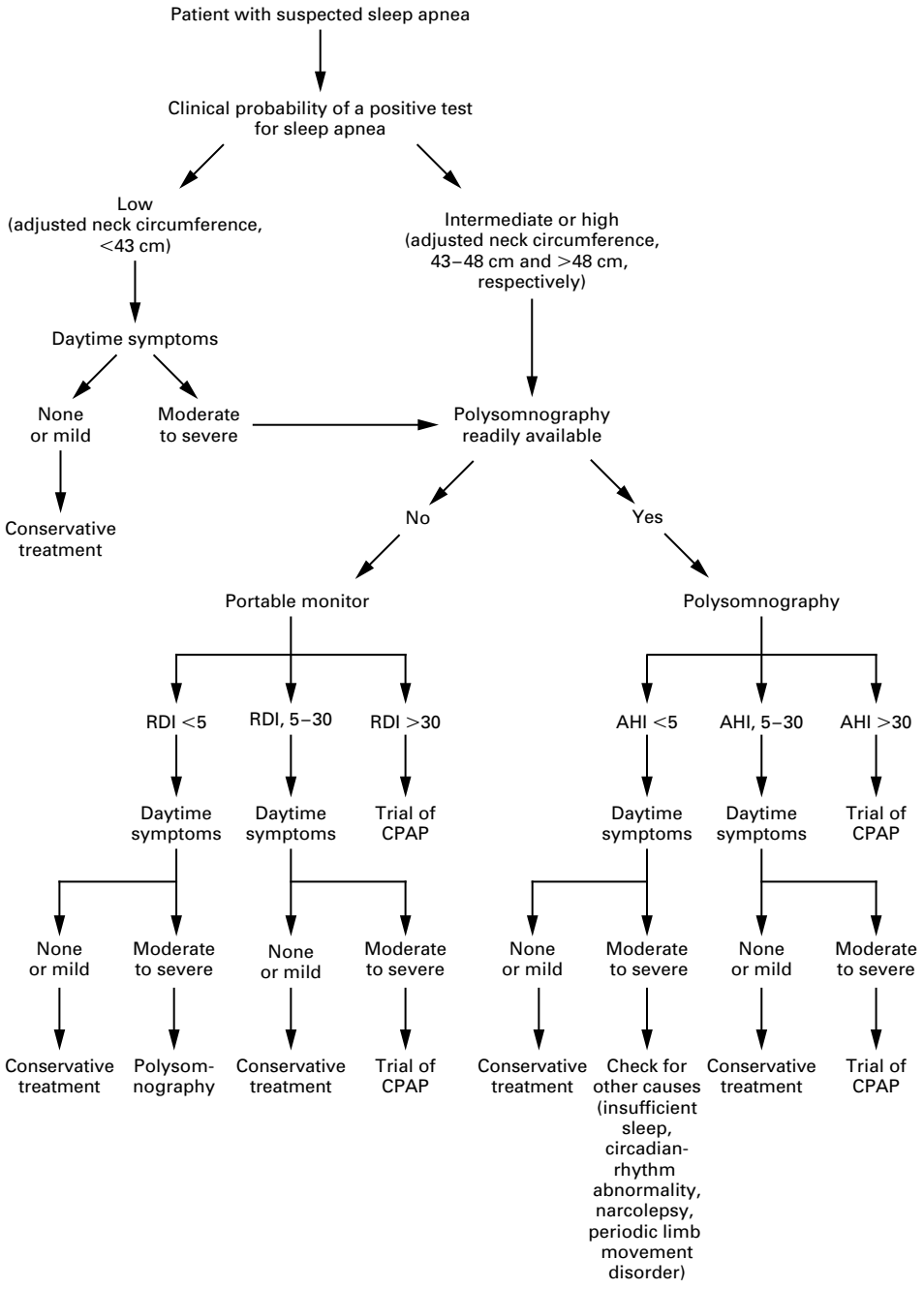

Figure 1. Approach to a Patient with Suspected Sleep Apnea.

The clinical probability that a sleep test (polysomnography or home monitoring) would be positive for sleep apnea is based on the adjusted neck circumference. Conservative treatment consists of weight loss, the use of a lateral sleep position, and avoidance of sedatives and alcohol. The respiratory disturbance index (RDI) is the number of breathing disturbances per hour of monitoring time. The apnea–hypopnea index (AHI) is the total number of episodes of apnea and hypopnea per hour of sleep. CPAP denotes continuous positive airway pressure.

STRATEGIES AND EVIDENCE

Diagnosis

Sleep apnea should be suspected in patients who are obese, hypertensive, habitual snorers, and hypersomnolent. In a primary care setting, patients with a high risk of sleep apnea were those who met two of the following three criteria: snoring, persistent daytime sleepiness or drowsiness while driving, and obesity or hypertension.[10] Combinations of clinical variables such as neck circumference or body-mass index, snoring, reports of nocturnal breathing disturbances, and hypertension have been used to predict which patients will have abnormal results on sleep tests.[11] The sensitivity of this approach can be high (78 to 95 percent), but the specificity tends to be low (41 to 63 percent).[11]

An adaptation of a prediction rule[12] based on neck circumference can be used to estimate a patient's probability of having a sleep-test result that is diagnostic of sleep apnea. Neck circumference (measured in centimeters) is adjusted if the patient has hypertension (4 cm is added), is a habitual snorer (3 cm is added), or is reported to choke or gasp most nights (3 cm is added). A low clinical probability corresponds to an adjusted neck circumference of less than 43 cm, an intermediate probability (4 to 8 times as probable as a low probability) to a neck circumference of 43 to 48 cm, and a high probability (20 times as probable) to a neck circumference of more than 48 cm. Together with the consideration of the severity of symptoms, the clinical-probability estimate helps guide management (Fig. 1).

Polysomnography

Polysomnography is the recommended method of assessing patients with suspected sleep disorders, including sleep apnea.[13] Sleep is recorded and the stage of sleep is determined by electroencephalography, electrooculography, and electromyography. Episodes of apnea and hypopnea are defined by a clear reduction in airflow or tidal volume, often accompanied by a decrease in oxygen saturation and terminated by an arousal (an interval of three seconds or longer in which the electroencephalographic pattern indicates that the patient is awake). In addition, breathing and limb movements and an electrocardiographic lead are monitored. However, the exact methods for recording breathing and the criteria for defining breathing disturbances, especially hypopnea, remain controversial.[14]

A recent meta-analysis of studies of the use of portable monitors for diagnosing sleep apnea concluded that the quality of most was not high[15]; however, better data supporting this approach are now being published. Portable monitors can provide clinically useful information on such variables as airflow, derived from a continuous measurement of nasal pressure, and oxygen saturation, derived by oximetry. Continuous measurement of nasal pressure has proved superior to previous methods involving thermistors, which only measure flow qualitatively and thus fail to detect subtle but nevertheless important breathing disturbances.[14] Using the results of polysomnography as the gold standard, Series et al.[16] found that home oximetry had a high sensitivity (98 percent) but a low specificity (48 percent) among 240 consecutively referred patients.[16] An automated analysis of a digitized oximetry signal was reported to improve specificity (to 88 percent) without compromising sensitivity.[17] The improved performance of this oximeter (Fig. 2) was most likely related to differences in the way in which the oximetry signal was analyzed. However, these results require confirmation in the home setting. Small studies that used nasal pressure as a surrogate measure of airflow reported sensitivities of 88 to 100 percent and specificities of 79 to 88 percent, as compared with polysomnography,[18,19] but additional research is needed.

In areas in which the availability of polysomnographs is limited, the use of portable monitors in selected patients could reduce demand. However, portable monitors should not be used in patients who have congestive heart failure, cerebrovascular disease, or respiratory failure.

Treatment

Continuous Positive Airway Pressure

Recommendations for treating sleep apnea, based on the apnea–hypopnea index or the severity of oxygen desaturation, are empirical. Polysomnographic studies obtained before and after treatment clearly demonstrate that continuous positive airway pressure immediately reverses apnea and hypopnea. In randomized, placebo-controlled trials, continuous positive airway pressure has been shown to decrease somnolence and to improve the quality of life, mood, and alertness.[20-22]

Short-term compliance with continuous positive airway pressure ranges from 50 to 80 percent, and the duration of average use ranges from 3.4 to 4.5 hours per night.[5] Some patients find continuous positive airway pressure obtrusive and become frustrated by frequent mask leaks and nasal congestion. Long-term use is more likely in patients with a history of snoring, a high apnea–hypopnea index, and severe daytime sleepiness.[23] Intensive support of patients when continuous positive airway pressure is initiated is important to maximize the likelihood of long-term use.[24] Assessment of symptoms and the quality of life after initiation of continuous positive airway pressure is particularly important in patients in whom the relation of symptoms to abnormal sleep patterns is unclear.

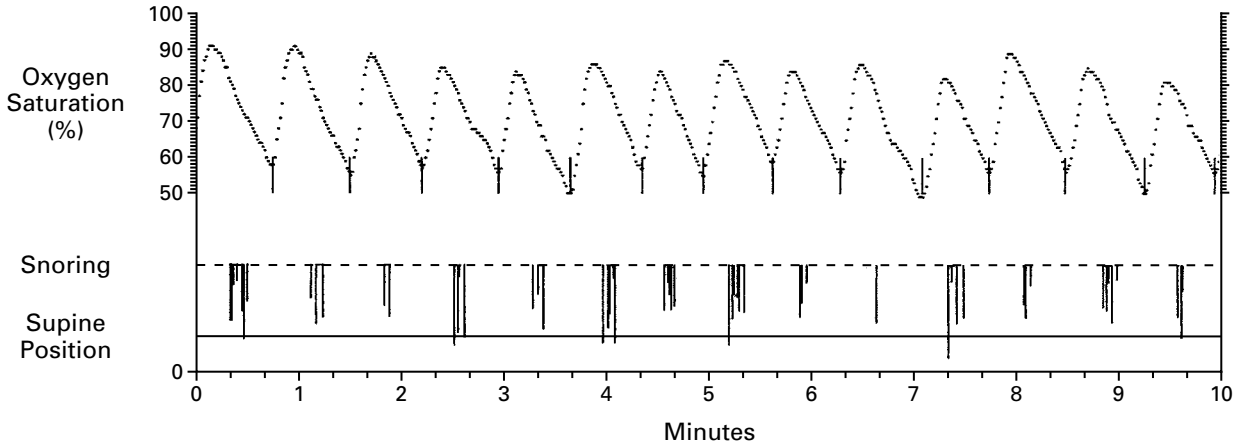

Figure 2. Pattern of Oxygen Saturation in a Patient with Severe Sleep Apnea.

The vertical lines below the oxygen saturation values indicate respiratory disturbances. Episodes of snoring are shown. The monitor has recorded the patient's position as supine.

Commencing Continuous Positive Airway Pressure Therapy

The level of continuous positive airway pressure required to restore upper-airway patency is traditionally determined during polysomnography by trained technicians. Some continuous positive airway pressure machines automatically adjust the pressure on the basis of the patterns of inspiratory airflow and can be used without polysomnography.[25-27] Alternatively, such self-adjusting machines can be used for several nights with portable monitors that track respiratory events, oxygen saturation, and pressure profiles.[28,29] A printed report of these data can then be used to estimate a fixed level of airway pressure for a non–self-adjusting continuous positive airway pressure device, since such devices are less expensive than the self-adjusting models. Either strategy has the potential to substitute for polysomnography. There are no controlled trials comparing outcomes among patients using self-adjusting continuous positive airway pressure devices with those among patients using fixed-level devices.

Conservative Treatment and Weight Loss

Conservative treatment strategies include the use of a lateral sleeping position, avoidance of alcohol or sedative medications, and weight loss. Studies have shown that the frequency of apnea and hypopnea is greater with a supine sleeping position[30] and after use of a benzodiazepine[31] or alcohol.[32] A 10 percent weight loss was associated with a 26 percent decrease in the apnea–hypopnea index in a population-based study.[33] There are no controlled trials comparing medically and surgically induced weight loss as a treatment for sleep apnea.[34] In an observational study, an average weight loss of 10 kg reduced the mean apnea–hypopnea index from 55 to 29.[35] Surgically induced weight loss (ranging from 27 to 100 kg) reduced the mean apnea–hypopnea index in 15 patients from 97 to 11.[36] Recurrence of sleep apnea has been reported after an initial response to surgically induced weight loss, despite the fact that the weight was not regained.[37] Weight loss should be recommended for all obese patients with sleep apnea; however, weight loss takes time, and only a minority of patients successfully maintain it. As a primary treatment, weight loss should be targeted toward patients with mild-to-moderate disease, especially if they are not interested in other options.

Mandibular and Tongue Advancement

Many types of oral appliances have been designed for the treatment of sleep apnea; most are custom fit to the teeth of both dental arches to reposition the mandible and, hence, to modify the retropalatal and retrolingual airway space. This treatment is sometimes effective. In practice, however, the evidence to support its use is limited to one placebo-controlled trial,[38] in which it was more effective than placebo, and trials in which this approach was compared with surgery[39] and continuous positive airway pressure[40,41] and found to be less effective than continuous positive airway pressure in reducing the frequency of apnea and hypopnea. On the basis of the available data, mandibular advancement appears to be a possible but suboptimal alternative to continuous positive airway pressure in patients with mild-to-moderate sleep apnea.

Surgery

Surgical procedures for sleep apnea include uvulopalatopharyngoplasty, laser-assisted uvulopalatoplasty, tonsillectomy, partial resection or ablation of the tongue, major reconstruction of the mandible or maxillae, and tracheostomy. Uvulopalatopharyngoplasty involves resection of the tonsils (if present), uvula, and posterior palate and reorientation of the tonsillar pillars. Laser-assisted uvulopalatoplasty is performed while the patient is under local anesthesia and involves partial resection of the uvula and soft palate without resection of the tonsils or tonsillar pillars. A recent Cochrane review concluded that the data needed to conduct a systematic review of surgical procedures were lacking.[42] The reported rates of improvement in the apnea–hypopnea index with uvulopalatopharyngoplasty vary[43]; the rate of long-term effectiveness (as evidenced by a reduction in the apnea–hypopnea index of at least 50 percent and a postoperative apnea–hypopnea index below 10) is less than 50 percent.[44] The procedure has been associated with complications, including postoperative pain, bleeding, nasopharyngeal stenosis, changes in the voice, and in rare cases, death.[45]

A randomized trial comparing uvulopalatopharyngoplasty with mandibular advancement reported a response (defined by an apnea index of less than 5 [the total number of episodes of apnea per hour of sleep] or an apnea–hypopnea index of less than 10) in 51 percent of surgical patients, as compared with 78 percent of patients who received a mandibular-advancement appliance.[39]

AREAS OF UNCERTAINTY

Partial obstruction of the upper airway can lead to an increase in inspiratory airflow resistance that does not result in either apnea or hypopnea. The clinical significance of this increase remains unclear. The term "upper airway resistance syndrome" has been used to describe patients who have hypersomnolence and mild breathing disturbances, but it remains controversial how these relate to the obstructive sleep apnea–hypopnea syndrome.[14] There is ongoing debate about the diagnostic value of approaches that do not involve polysomnography; no professional organization currently endorses these approaches. However, there is good reason to expect that portable monitors, when combined with a clinical decision algorithm, can help to exclude the diagnosis in some patients and confirm it in others.

Management of the increased risk of motor vehicle accidents in patients with sleep apnea is also controversial. Most jurisdictions have regulations (either permissive or mandatory statutes) regarding the duties of physicians to report such accidents to state or provincial licensing authorities.[9]

GUIDELINES

The American Academy of Sleep Medicine (formerly the American Sleep Disorders Association) recommends polysomnography for the determination of the severity and treatment of sleep apnea.[13,45] Recognizing that portable unattended monitors are in use, the American Academy of Sleep Medicine recommends that they be used only by physicians experienced in diagnosing sleep apnea who also have access to full polysomnography in a sleep laboratory.[46] The American Thoracic Society recommends polysomnography to calculate the correct level of continuous positive airway pressure.[47] These guidelines were published several years ago and require updating.

The American Academy of Sleep Medicine does not recommend the use of laser-assisted uvulopalatoplasty as a substitute for surgical uvulopalatopharyngoplasty for the treatment of sleep apnea, although both procedures can decrease snoring.[48] It does recommend that all patients who are being considered for laser surgery undergo polysomnography or at a minimum a portable monitoring study to exclude sleep apnea.

The American Thoracic Society recommends that patients who are at high risk for motor vehicle accidents (e.g., those with severe hypersomnolence and a history of motor vehicle accidents) be notified of their increased risk and that a physician take immediate measures to reduce this risk.[9]

CONCLUSIONS AND RECOMMENDATIONS

The diagnosis of sleep apnea should be based on both symptoms and the magnitude of respiratory disturbances. Using cutoff values for a continuous variable such as the apnea–hypopnea index to define sleep apnea can be problematic, and decisions about treatment should not be made on the basis of this index alone. Results obtained with clinical prediction rules, portable monitors, and polysomnography should be reviewed in the context of the clinical presentation. Patients who have severe symptoms or who have serious coexisting illnesses such as ischemic heart disease require a lower threshold for initiating treatment and a greater need for diagnostic accuracy than an otherwise healthy person. Polysomnography remains the gold standard for the evaluation of patients suspected of having sleep apnea; however, particularly in circumstances in which there may be a long wait before polysomnography can be scheduled, the use of a clinical decision algorithm and a validated portable monitor is an alternative. The monitor should display the events that it is recording as "respiratory disturbances," so that a physician can verify that such events do not represent artifacts. Measurement of oxygen saturation is important to identify episodes of serious

desaturation, since such episodes would indicate the need for more urgent treatment.

The patient described in the case vignette has a high probability of sleep apnea (a neck circumference of 53 cm after adjustment for hypertension and snoring) and should undergo testing. At my center, where waiting times for polysomnography exceed eight months, testing would be done at home with the oximeter used in Figure 2.

Once obstructive sleep apnea is diagnosed, continuous positive airway pressure is the treatment of choice. At centers in which polysomnography is available, this approach is usually used to determine the efficacy and optimal level of continuous positive airway pressure (in terms of reducing the apnea–hypopnea index) at the time of diagnosis. At centers in which portable monitors are used for the diagnosis, an initial trial of self-adjusted continuous positive airway pressure with home monitoring can be used to establish the level of airway pressure needed, with subsequent conversion to a fixed-level device, which is less expensive. In that case, follow-up monitoring at home is reasonable to ensure that the apnea–hypopnea index is adequately reduced (to below 5) with therapy. Symptoms, especially drowsiness while driving, should be reassessed in all patients after therapy is initiated. Weight loss should be encouraged in patients who are overweight, with the understanding that if weight loss is successful, the need for continuous positive airway pressure can be reassessed. If continuous positive airway pressure cannot be tolerated, I would suggest the use of a mandibular-advancement appliance, and I would consider uvulopalatopharyngoplasty only if this approach was unsuccessful.

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