

Colorado Children's Ear Nose and Throat, P.C.

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Sleep Apnea

WHAT IS SLEEP APNEA?

General Description of Sleep Apnea and Snoring

Sleep apnea is a disorder in which a person stops breathing during the night, perhaps hundreds of times, usually for periods of 10 seconds or longer and sometimes for as long as a minute. In most cases the person is unaware of it, although sometimes they awaken and gasp for breath. It is usually accompanied by snoring. People who have sleep apnea may not even be aware of the condition, but it inevitably causes daytime sleepiness.

Sleep apnea is generally categorized as obstructive, central, or mixed. A less severe form of obstructed breathing called upper airway resistance syndrome (UARS) is also worth mentioning.

Obstructive Sleep Apnea

Obstructive sleep apnea (OSA), the most common form of apnea, occurs when tissues in the upper throat (or airway) collapse at intervals during sleep, thereby blocking the passage of air. In general, OSA occurs as follows:

- On its way to the lungs, air passes through the nose, mouth, and throat (known as the upper airway).
- Under normal conditions, the back of the throat is soft and pliant and tends to collapse inward as a person breathes.
- Certain muscles, called dilator muscles, work against this to keep the airway open. Interference or abnormalities in this process causes air turbulence.
- In some cases, the interference is incomplete (called obstructive *hypopnea*) and causes continuous but slow and shallow breathing. In response the throat vibrates and makes the sound of snoring. Snoring can occur whether a person breathes through the mouth or the nose. (It should be noted that snoring also occurs without sleep apnea.)
- If the tissues at the back of the throat collapse and become momentarily blocked, *apnea* occurs. (Apnea literally meaning absence of breath.)
- Apnea decreases the amount of oxygen in the blood, and eventually this lack of oxygen triggers the lungs to suck in air.

- At this point, the patient may make a gasping or snorting sound but does not usually fully wake up.

Central Sleep Apnea

Central sleep apnea is much less common. It is caused by some problem in the central nervous system, most likely a failure of the brain to signal the airway muscles to breathe. In such cases, oxygen levels drop abruptly and usually the sleeper wakes with a start. Often people with central sleep apnea recall waking up. They generally experience less sleepiness during the day than people with obstructive sleep apnea.

Mixed Apnea

Mixed apnea is the term used when the two apneas occur together.

Upper Airway Resistance Syndrome (UARS)

Upper airway resistance syndrome (UARS) is a condition in which patients complain about excessive daytime sleepiness and they may snore and wake frequently during the night. However, UARS patients do not have the breathing abnormalities that characterize sleep apnea and they do not show reduction in oxygen levels in the blood. Unlike apnea, UARS is more likely to occur in women than in men. Treatments are similar to those of sleep apnea. It is not known if UARS has any serious health complications.

HEALTHY SLEEP

Circadian Rhythm

In sleep studies, subjects spend about one-third of their time asleep, suggesting that most people need about eight hours of sleep each day. Individual adults differ in the amount of sleep they need to feel well rested, however. (Infants may sleep as many as 16 hours a day.)

The daily cycle of life, which includes sleeping and waking, is called a *circadian* (meaning "about a day") rhythm, commonly referred to as the biologic clock. Hundreds of bodily functions follow biologic clocks, but sleeping and waking comprise the most prominent circadian rhythm. The sleeping and waking cycle is approximately 24 hours. (If confined to windowless apartments, with no clocks or other time cues, sleeping and waking as their bodies dictate, humans typically live on slightly longer than 24-hour cycles.) It usually takes the following daily patterns:

- Humans are designed for daytime activity and nighttime rest.
- Additionally, there is a natural peak in sleepiness at mid-day, the traditional siesta time.

In addition, daily rhythms intermesh with other factors that may interfere or change individual patterns:

- The fraction-of-a-second-firing of nerve cells in the brain may be faster or slower in different individuals.

- The monthly menstrual cycle in women can shift the pattern.
- Light signals coming through the eyes reset the circadian cycles each day, so changes in season or various exposures to light and dark may unsettle the pattern. The importance of sunlight as a cue for circadian rhythms is dramatized by the problems experienced by people who are totally blind: they commonly have trouble sleeping and other rhythm disruptions.

The Response in the Brain to Light Signals

The response to light signals in the brain is an important key factor in sleep:

- Light signals travel to a tiny cluster of nerves in the hypothalamus in the center of the brain, the body's master clock, which is called the *supra chiasmatic nucleus* or SCN.
- This nerve cluster takes its name from its location, which is just above (*supra*) the optic chiasm. The optic chiasm is a major junction for nerves transmitting information about light from the eyes.
- The approach of dusk each day prompts the SCN to signal the nearby *pineal gland* (named so because it resembles a pine-cone) to produce the hormone melatonin.
- *Melatonin* is thought to act as the body's time-setting hormone. The longer a person is in darkness the longer the duration of melatonin secretion. Secretion can be diminished by staying in bright light. Melatonin also appears to serve as a trigger for the need to sleep.

Sleep Cycles

Sleep consists of two distinct states that alternate in cycles and reflects differing levels of brain nerve cell activity. During a normal night's sleep, one progresses through these stages about five or six times:

Non-Rapid Eye Movement Sleep (NonREM). NonREM sleep is also termed quiet sleep. NonREM is further subdivided into three stages of progression:

- Stage 1 (light sleep).
- Stage 2 (so-called true sleep).
- Stage 3 to 4 (deep "slow-wave" or delta sleep).

With each descending stage, awakening becomes more difficult. It is not known what governs NonREM sleep in the brain. A balance between certain hormones, particularly growth and stress hormones, may be important for deep sleep.

Rapid Eye Movement Sleep (REM). REM sleep is termed active sleep and is believed by some experts to be regulated by the circadian clock in the hypothalamus. Most vivid dreams occur in REM sleep. REM-sleep brain activity is comparable to that in waking, but the muscles are virtually paralyzed, possibly preventing people from acting out their dreams. In fact, except for vital organs like the lungs and heart, the only muscles not paralyzed during REM are the eye muscles. REM sleep may be critical for learning and for day-to-day mood regulation. When people are sleep-deprived, their brains must work harder than when they are well rested.

The REM/NonREM Cycle. The cycle between quiet (NonREM) and active (REM) sleep generally follows this pattern:

- After about 90 minutes of NonREM sleep, eyes move rapidly behind closed lids, giving rise to REM sleep.
- As sleep progresses the NonREM/REM cycle repeats.
- With each cycle, NonREM sleep becomes progressively lighter, and REM sleep becomes progressively longer, lasting from a few minutes early in sleep to perhaps an hour at the end of the sleep episode.

WHAT ARE THE SYMPTOMS OF SLEEP APNEA?

Symptoms in Adults

People with sleep apnea usually do not remember waking up during the night. Indications of the problem may be such vague symptoms as the following:

- Excessive daytime sleepiness.
- Morning headaches.
- Irritability and even impaired mental or emotional functioning.
- Snoring. Bed partners may report very loud and interrupted snoring.
- Heartburn. (Acid back up that causes heartburn, in fact, may be responsible for some cases of sleep apnea.)

Symptoms in Children

Children may exhibit symptoms that differ from adults, including the following:

- Longer total sleep time than normal in some children, especially obese children or those with severe apnea.
- Snoring. (It should be noted that an estimated 3% to 12% of all children snore. However, not all of them have sleep apnea.)
- Behavioral difficulties without any obvious cause, such as hyperactivity and inattention. (Some patients may even be misdiagnosed with attention-deficit hyperactivity disorder.)
- Irritability.
- Bed-wetting.
- Morning headaches.
- Failure to grow and gain weight.

- More effort in breathing (flaring nostrils, heaving chests). At night the chest may have an inward motion during sleep.

WHAT CAUSES SLEEP APNEA?

Structural Abnormalities

Any structural abnormality in the face, skull, or airways that causes some obstruction in the upper airways and reduces air pressure can produce sleep apnea syndrome. Among the most likely structural causes of many cases of sleep apnea are abnormalities in tissues that lie between the back of the mouth and the esophagus (food pipe), including the soft palate, the base of the tongue, and surrounding throat walls, that make them collapse more easily during breathing. Enlarged soft palates have been particularly associated with apnea.

Nerve, Metabolic, and Mechanical Abnormalities

Researchers have identified myriad physiologic abnormalities that may play a role in causing sleep apnea or in making it worse. These include an inability to regulate levels of carbon dioxide, impaired brain and nervous system responsiveness to various chemical messengers, and poor reflexes or muscle tone in the upper airways. The underlying reasons for these disturbances and their connection to apnea require further study.

Obesity

Obesity is strongly associated with sleep apnea and there is some evidence it may be a cause of it. Imaging scans have shown fatty cells infiltrating the throat tissue, which suggests that they could narrow the airways. In one study, the more obese a person with sleep apnea was, the higher the pressure on the airway and therefore the greater the obstruction of the airway. (Obstructive sleep apnea may also contribute to obesity itself, however. A sleepy person tends to be sedentary.)

Sleep Behaviors

Snoring. Chronic snoring itself may actually be a cause of some cases of sleep apnea. Over time the vibrations and the increased pressure against the upper airways as snoring people inhale may cause the soft palate to lengthen. This stretched palate is more prone to collapse and obstruction.

It should be stressed that snoring is very common. Snoring occurs in about a third of the population, while apnea, according to one study, occurs in only 6%. Snoring, then, does not always cause apnea, nor is it always a sign of the respiratory disorder. Furthermore, while snoring is also associated with daytime sleepiness regardless of whether apneas are present, snoring alone does not appear to pose any major health risks.

Mouth Breathing. Some evidence suggests that a tendency to breathe through the mouth (rather than the nose) during childhood can actually produce structural changes in the face (longer face, narrow jaw, receding chin). Such facial characteristics may eventually put people at risk for sleep apnea. [*For a description of these physical characteristics, see Who Has Sleep Apnea?*]

Causes of Sleep Apnea in Small Children

Sleep apnea can occur even in very young children. The most likely causes are the following:

- Facial or skull abnormalities in infants.

- Overgrown tonsils, adenoids, or both in small children. (Removal of tonsils or adenoids can free the airways and solve the problem.)
- Premature infants also commonly have a form of apnea that may be related to lung or nervous system problems.

WHO HAS SLEEP APNEA?

Some researchers estimate that 12 to 25 million Americans have sleep apnea, but less than a million are aware of it.

General Risk Facts

Gender. More men than women appear to have sleep apnea. A range of studies has reported apnea or hypopnea (shallow nighttime breathing) in 9% to 25% of men and 4% to 15% of women. Sleep apnea may be under-diagnosed in women, particularly in older women. In general, older women have the same incidence as men their own age. It is not clear why apnea occurs more often after menopause. Although women tend to gain weight and develop larger necks after menopause, a 2001 study suggested that these factors were not the only reason for the increase in sleep apnea in postmenopausal women.

Age. Sleep apnea is most common and its symptoms are worse in middle-aged adults (between 40 and 60 years old). Nevertheless, it affects people of all ages, and, in fact, has been reported in between 1.6% to 3.4% of children. Some experts believe that sleep-disordered breathing may occur in as many as 11% of children.

Interestingly, one study suggested that although the prevalence of sleep apnea increases with age, its health consequences decline. In the study, apnea posed more of a threat to a person's health before age 45 than afterward.

Ethnicity. African Americans face a higher risk for sleep apnea than any other ethnic group in the United States. Other groups at increased risk include Pacific Islanders and Mexicans.

Geography. According to one study, although urban dwellers are more likely to report disturbed sleep, particularly as a result of stress, rural dwellers have a significantly higher risk for apnea.

Obesity

Obesity, especially having fat around the abdomen (the so-called apple shape), is a particular risk factor for sleep apnea, even in adolescents and children. It should be noted, however, that many people with sleep-related breathing disorders, particularly women and small children, are not obese.

Physical Characteristics

Having a Larger Neck. Having a large neck is a risk factor for sleep apnea. In fact, the larger necks in men may be the primary reason for their higher risk for sleep apnea compared to women. A neck measurement of 17 inches or greater in men or at least 16 inches in women is one indicator that may suggest the condition. Postmenopausal women are more likely than younger women to have sleep apnea, in part because they tend to be heavier and have larger necks.

Specific Facial and Skull Characteristics. Structural abnormalities in the face and skull may be responsible for many cases of sleep apnea, particularly those that occur in non-obese patients and those

with early-onset (before age 20) sleep apnea that is related to a family history of apnea. Specific physical characteristics that may increase the risk for sleep apnea in both adults and children include the following:

- A long lower part of the face.
- Brachycephaly (a birth defect in which the head tends to be shorter and wider than average). (Brachycephalia may be a risk factor in Caucasians, but not in African Americans.)
- A narrow upper jaw.
- A receding chin.
- An overbite.
- A larger tongue.

Characteristics in the Soft Palate Throat. Some people have specific abnormalities in the soft palate (the soft area at the back of the mouth) and throat that may prove to cause sleep apnea:

- The soft palate and the walls of the throat around it collapse easily.
- The soft palate is stiffer, larger than normal, or both.

Body Position while Sleeping

Often, body position greatly affects the number and severity of episodes of obstructive sleep apnea, with at least twice as many apneas occurring when a person lies face upward than when the person lies on his or her side. This may be due to the effects of gravity, which cause the throat to narrow when a person lies on the back. (Indeed, astronauts show a marked reduction in apneas and snoring in the weightlessness of space.)

Smoking and Alcohol Use

Smoking. Smokers are at higher risk for apnea, with heavy smokers (more than two packs a day) having a risk 40 times greater than nonsmokers.

Alcohol. Alcohol use has been associated with apnea, although studies are mixed. A major 1999 survey reported that 53% of people who use alcohol to sleep experience symptoms of sleep apnea. Another study found no relationship.

Medical Conditions Related to Sleep Apnea

Diabetes. Diabetes is associated with sleep apnea and snoring. It is not clear if there is an independent relationship between the two conditions or whether obesity is the only common factor.

Gastroesophageal Reflux Disease (GERD). Gastroesophageal reflux disease (GERD) is a condition caused by acid backing up into the esophagus and is a common cause of heartburn. GERD and sleep apnea often coincide. In one study, almost half of apnea patients had symptoms of GERD, and these symptoms also tend to be worse at night and in the morning and particularly hard to treat. Some experts suggest that the back of up of stomach acid in GERD may produce spasms in the vocal cords (larynx), thereby blocking the flow of air to the lungs and causing apnea. Or, apnea itself may cause pressure changes that trigger GERD. It should be noted, however, that obesity is frequent in both conditions and may be the common factor. More research is needed to clarify the association. [For more information,

see, *Heartburn and Gastroesophageal Reflux Disease*.]

Polycystic Ovary Syndrome (PCOS). In one 2000 study, women with polycystic ovary syndrome (PCOS) were 30 times more likely than other premenopausal women to have obstructive sleep apnea and excessive daytime sleepiness. In PCOS women produce high amounts of androgens (male hormones), particularly testosterone. The elevated levels of male hormones can cause obesity, facial hair, and acne. About half of PCOS patients also have diabetes. Obesity and diabetes are both associated with sleep apnea and may be the common factors.

Chronic Problems in the Upper Airways. A 2001 Swedish study found that people with respiratory tract disorders, including asthma, chronic bronchitis, or seasonal allergies, reported symptoms of sleep apnea more often than those without any of these ailments. Not all research supports the association, however, and more studies are needed.

HOW SERIOUS IS SLEEP APNEA?

Higher Risk for Accidents

As many as 200,000 automobile accidents in the US and 1,500 deaths from such accidents are caused by sleepiness. Studies continue to report that drowsy driving is as risky as drunk driving. Estimates on fatigue as a cause of automobile crashes range from 1% to 56%, depending on the study. In a major 1995 poll, for example, 33% of those surveyed said they had fallen asleep while driving, and 10% of these people had had accidents because of this. One study strongly suggested that it was *habitual* sleepiness, however, and not just being sleepy at the time of an accident that places people at higher risk.

Furthermore, some researchers believe that sleepiness associated with sleep apnea is the greatest risk factor for car accidents. Two studies in 1997 and 1998, respectively, reported that people with sleep apnea have two to three times as many car accidents, and five to seven times the risk for multiple accidents.

Sleep Apnea as a Cause of Obesity

Obesity and sleep apnea are a chicken and egg problem. It is not always clear which condition is responsible for the other. For example, obesity is often a risk factor and possibly a cause of sleep apnea, but it is also likely that sleep apnea increases the risk for weight gain:

- Some studies indicate that sleep apnea disrupts rapid eye movement (REM) sleep, which, in turn, increases the risk for obesity.
- Research indicates that animals deprived of REM sleep tend to eat more.
- People with apnea may also become too tired to exercise and so put on weight.

Adverse Effects of Sleep Apnea on Heart and Circulation

Sleep apnea has a strong association with heart and circulation diseases. The links are not fully clear. Researchers are intensively investigating why a problem in the upper airways is associated with these serious conditions. Here are some findings:

- Obesity, smoking, and alcohol abuse, known risk factors for hypertension and heart disease, are also associated with sleep apnea. These factors however, do not explain all cases of higher

heart-related risks in people with sleep apnea. For example, among overweight people, those who have sleep apneas have a greater risk of heart problems than those without them.

- When breathing stops during episodes of apnea, carbon dioxide levels in the blood increase and oxygen levels drop. This effect may trigger a cascade of physical and chemical events that can then increase risk for these conditions.
- Apnea also causes decreased levels of the gas nitric oxide (NO), a potent substance that causes blood vessels to be elastic and expand. NO plays a crucial role in blood pressure control and heart health.
- Apnea may also increase levels of a substance called angiotensin-converting enzyme (ACE), which is known to play a role in high blood pressure and congestive heart failure.
- Researchers have reported high levels of certain immune factors called tumor necrosis factor-alpha (TNF-alpha) and interleukin 6 (IL-6) in people with sleep apnea, particularly those who are obese. High levels of TNF-alpha and IL-6 produce a damaging inflammatory response, which can harm cells in the body, including those in the arteries. Elevated TNF-alpha was associated in one study with fatigue, shortness of breath, and a diminished heart-pumping action.

At this time, however, evidence of a clear causal relationship with any of these health problems is still weak. Some studies have found no significant independent risk for heart disease from obstructive sleep apnea. The following are some discussions on the possible effects of apnea on specific health problems.

High Blood Pressure. A number of studies have found a strong association between sleep apnea and high blood pressure (hypertension). For example, a 2000 study followed patients for four years and reported that the greater the number of nightly apnea episodes they had in year one the more likely they were to develop hypertension by the fourth year. A weak but still higher than normal association with high blood pressure has even been observed in those who snore, wake frequently during the night, or have mild sleep apnea.

The relationship between sleep apnea and hypertension has been thought to be largely due to obesity, a risk factor common to both conditions. Recent and major studies, however, are suggesting a higher rate of hypertension in people with sleep apnea regardless of weight. In those whose hypertension is resistant to treatment, sleep apnea is likely to be particularly severe.

The following is one way that apnea may directly affect blood pressure, regardless of other risk factors:

- Blood pressure fluctuates widely and suddenly in response to episodes of apnea and hypopnea (shallow nighttime breathing).
- Such fluctuations are possibly due to a sudden surge in the sympathetic nervous system, which controls involuntary muscle responses, importantly those in the blood vessels and heart, and may also play a role in sleep apnea.
- These fluctuations lead to transient constriction of blood vessels that, over time, could possibly lead to sustained hypertension and heart damage.

Stroke. Sleep apnea appears to increase the chance for a stroke independent of its association with high blood pressure (a known risk factor for stroke). Sleep apnea is also thought to be related to small strokes called transient ischemic attacks (TIAs). Sleep apnea in stroke patients is also associated with a higher risk for worse symptoms after a stroke, including delirium, depression, poor response to verbal stimuli, and difficulty conducting daily chores. How sleep apnea increases these risks is under investigation. Some theories are as follows:

- One 2000 study observed that blood becomes more viscous (stickier) in the morning in people with obstructive sleep apnea compared to people without the sleep disorder. Such "sticky" blood is more apt to form clots that can lead to strokes. To support this, another 2000 study reported that stroke victims with sleep apnea tended to have higher levels of the blood protein fibrinogen than stroke victims without sleep apnea. Fibrinogen is a factor in blood that causes it to clot. Higher levels of fibrinogen have been linked to both strokes and heart attacks.
- A 1998 study reported that the carotid artery, the major artery to the brain, is in far greater danger of becoming *sclerotic* (hardened and narrower) in people with obstructive sleep apnea than in the average person. People with both diabetes and sleep apnea are at particularly high risk for this effect.
- One small 1998 study reported a drop in blood flow in the brain during episodes of obstructive hypopnea (slow and shallow breathing associated with snoring). This may also increase the risk of stroke. Such declines in blood flow did not appear to occur with obstructive or central *apnea*, however.

Coronary Artery Disease and Heart Attack. In one 2001 study, researchers observed that the more episodes of apnea and hypopnea a patient had, the higher the risk for a heart attack. Many of the factors associated with stroke and sleep apnea (a risk for blood clots and narrowing of the arteries) may also increase the risk for heart attacks. A 2002 study reported that the white blood cells of patients with apnea have an increased number of proteins called adhesion molecules on their surface that may bind to the lining of blood vessels and cause inflammation. Increasingly, scientists believe that inflammation plays an important role in the development of coronary artery disease, heart attacks, and many other major ailments. Still, evidence suggests that the effect of apneas on coronary artery disease and heart attack may not be as significant as it is on heart failure and strokes.

Heart Failure. The evidence for an association between heart failure and sleep apnea is suggested by the following:

- High blood pressure, which is associated with sleep apnea, is a major cause of later heart failure.
- In addition, a 2001 study reported a higher number of apneas in patients with left ventricular hypertrophy. This is an overgrowth of the heart's left ventricle (main pumping chamber) that impairs the heart's beating action over time and is a major factor in many cases of heart failure, though risk factors other than apnea, such as obesity, advancing age, or high blood pressure, may be to blame. More research is needed to determine the relationship between apnea and heart function.

Central sleep apnea is particularly linked with heart failure. In any case, obstructive sleep apnea can affect breathing functions in a way that may be particularly harmful for patients with existing congestive heart failure. A 1999 study, in fact, indicated that sleep apnea is associated with poorer survival in patients with heart failure.

Other Adverse Effects on Health

- Sleep apnea is associated with a higher incidence of many medical conditions, other than heart and circulation. The links between apneas and the conditions are unclear.
- Pulmonary hypertension.
- Diabetes.
- Kidney failure.

- Peripheral nerve damage (e.g., tingling, pain, or numbness in the hands and feet).
- Seizures, epilepsy, and other nerve disorders. Sleep apnea appears to pose a particularly risk for nocturnal epilepsy (in which seizures occur during sleep.)
- Headaches. Some studies strongly suggest that for some people sleep disorders, including apnea, may be the underlying causes of some chronic headaches. In some patients with both chronic headaches and apnea, treating the sleep disorder has been known to cure the headache, even the very severe and disabling form known as a cluster headache.
- Irregular menstrual periods. This occurs in about 40% of premenopausal women. It is not clear how they are related, but one study reported that treating apnea helped normalize periods.
- Eye disorders, including glaucoma, conjunctivitis, dry eye, and various other infections and irritations. A condition called intracranial hypertension has been observed as well in some patients with sleep apnea, which may also damage vision.
- Possibly, Alzheimer's disease.

Effects on Emotions and Thinking in Adults

Mental Issues in Adults . One study found that older people with sleep apnea and daytime sleepiness have lower scores on tests for cognitive functions. One expert suggested that treating sleep apnea in older patients may correct some cases of dementia that are caused by sleep disturbances. Elderly people with sleep apnea may also be more prone to depression.

Emotional Effects of Sleep Apnea. Studies report an association between severe apnea and psychological problems. In one study, 32% of patients had symptoms of depression. Sleep-related breathing disorders can also exacerbate nightmares and post-traumatic stress disorder. In fact, in one study, treatment of sleep apnea eased these complaints. Certainly, daytime sleepiness interferes with quality of life. It is also possible that severe emotional problems might worsen the apnea. One study investigated the effects of the antidepressant paroxetine (Paxil) on patients with obstructive sleep apnea. The agent improved breathing during late sleep stages but had little effect on other aspects of obstructive sleep apnea.

Effects on Bed Partners

Because sleep apnea so often includes noisy snoring, the condition can also adversely affect the sleep quality of a patient's bed partner. Spouses or partners may also suffer from sleeplessness and fatigue. In some cases, the snoring can even disrupt relationships. Diagnosis and treatment of sleep apnea in the patient can, of course, help eliminate these problems.

Effects in Infants and Children

Failure to Thrive. Small children with undiagnosed sleep apnea may "fail to thrive," that is, they do not gain weight or grow at a normal rate and they have low levels of growth hormone. In severe cases, this may affect the heart and central nervous system. Most often sleep apnea is caused by overgrown tonsils or adenoid. Their removal often completely solves all of these problems, including resolution of sleep apnea and restoring weight gain and normal growth hormone levels.

Behavioral Issues in Children. If the sleep apnea goes undiagnosed, over time it may also lead to sleep deprivation and behavioral problems as children get older. Children with sleep apnea are at higher risk for behavioral problems, such as hyperactivity and inattention. (Even children who snore and do not have sleep apnea may be at higher risk for poor concentration.)

HOW IS SLEEP APNEA DIAGNOSED?

General Guidelines for Diagnosing Sleep Apnea

Candidates for Diagnostic Work-Up. Some experts advise diagnostic sleep studies for the following individuals:

- People who habitually snore and are sleepy during the day.
- People who habitually snore and have observable breathing irregularities, even if they are *not* sleepy during the day.

In some cases, such patients may need to consult a sleep specialist or go to a sleep disorders center. At most sleep disorders centers, patients undergo an in-depth analysis, usually supervised by a multi-disciplinary team of consultants who can provide both physical and psychiatric evaluations. Centers should be accredited by the American Academy of Sleep Medicine. [See Where Else Can Help for Sleep Apnea Be Obtained? *below.*]

Determining Abnormal Apneas after a Diagnosis. Once apnea has been diagnosed, the question of whether it is abnormal enough to require treatment is an issue of some debate for the following reasons:

- The number of apneas per hour does not always relate directly to daytime sleepiness. Experts, then, do not always agree on what constitutes an abnormal number of apneas per hour. In fact, the cut-off number considered abnormal enough to require treatment ranges from five to 15 per hour, depending on the particular sleep center's criteria.
- The development of sophisticated testing devices now allows physicians to detect a wide spectrum of apnea-like disorders. They range from simple snoring to upper airway obstruction without apnea to severe, repetitive, and complete airway closure. It is not clear at what level such disorders may threaten health. Increasingly, some experts, but not all, are looking at the lowest range as an indicator of health problems.

Medical and Sleep History

To help determine sleep apnea, the physician needs the answers to a number of questions, including the following:

- Is the patient taking any medications?
- How many periods of sleepiness are there each day and when do they occur? (Patients with apnea often do not describe this symptom as feeling "sleepy." They are more apt to describe this feeling as "lack of energy" or "feeling tired all day.")
- How restful is sleep?
- Do headaches occur regularly in the morning?
- Is the patient taking or withdrawing from stimulants, such as coffee or tobacco?
- How much alcohol is consumed per day?
- Does the patient have any problems with mental or emotional functioning?

- Does the patient suffer from heartburn?
- What is the normal sleeping position (back, side, or stomach)?
- If there is a sleeping partner, does he or she complain about the patient's snoring or gasping for breath? (Many times it is useful to interview the bed partner.)

Keeping a Record of Sleep. To help answer these questions, the patient may need to keep a sleep diary. Every day for two weeks, the patient should record all sleep-related information, including responses to questions listed above described on a daily basis. Recording sleep behavior using an extended-play audio or videotape can be very helpful in diagnosing sleep apnea.

Physical Examination

To diagnose sleep apnea, the physician will check for physical indications of sleep apnea, including the following:

- Abnormalities in the soft palate or upper airways, including enlarged tonsils.
- Upper body obesity.
- A wide neck measurement.

One study reported that by taking measurements of body mass, neck circumference, and four areas inside the mouth physicians were able to accurately diagnose 98% of people with suspected sleep apnea.

Ruling Out Other Disorders

If sleep apnea is not obvious after a physical examination and history, the physician will need to rule out any other conditions, such as chronic fatigue syndrome or depression, that may be causing daytime sleepiness.

Polysomnography

Overnight polysomnography involves many measurements and is typically performed in a sleep center.

The patient arrives about two hours before bedtime without having made any changes in daily habits. Polysomnography electronically monitors the patient as he or she passes, or fails to pass, through the various sleep stages. Polysomnography tracks the following:

- Brain waves.
- Body movements.
- Breathing.
- Heartbeats. One study suggested that many patients with obstructive sleep apnea display distinctive heart rhythms as detected by electrocardiogram (ECG).
- Eye movements.

Changes in breathing and the levels of oxygen in the blood are also recorded. In patients with suspected sleep apnea, the sleep expert will track instances of apnea and hypopnea that last longer than 10 seconds. In general, if there are more than 5 episodes per hour, apnea is significant and if there are more than 15, the condition is serious.

Overnight polysomnography has been the gold standard for diagnosing obstructive sleep apnea in both adults and children. It is very labor intensive and expensive, however, and also misses snoring-induced arousals. A full set of tests including a night at a sleep clinic may cost \$2,000 to \$3,000 and is not always covered by insurance.

Home Diagnostic Devices

A number of devices are being developed so that patients will have the convenience of being monitored without professional assistance at home. Experts hope that they eventually will replace the need for overnight sleep clinics or the need for attended monitoring at home.

Overnight Video Recording and Oxygen Monitoring. At-home video monitoring under infrared light with audio may prove to be an expensive and accurate diagnostic method when used in combination with tests that measure blood oxygen levels and heart rate.

Unattended Monitoring with Auto-CPAP. This method is a recent and simple method for detecting impaired breathing. It uses an auto-CPAP machine, which is programmed to apply pressure through the airways via a tube that attaches to a mask that fits the nose. A monitor is attached that digitizes and records on a computer all the information on any apnea episodes during sleep.

Nasal Pressure Recording. One promising technique uses a very simple prong device that attaches to the nostrils. A monitor records the airflow through the mouth and nose.

Peripheral Arterial Tonometry. An investigative technique called peripheral arterial tonometry measures changes in blood flow in the arteries of the finger tips during sleep. Such measurements are proving to be accurate in detecting sleep apnea in 80% of cases.

Measuring Sleepiness

The Epworth sleepiness scale uses a simple questionnaire to measure excessive sleepiness during eight situations. [See Box [The Epworth Sleepiness Scale.](#)]

THE EPWORTH SLEEPINESS SCALE	
SITUATION	CHANCE OF DOZING
	(Indicate a score of 0 to 3) 0 = no chance of dozing, 1 = slight chance of dozing, 2 = moderate chance of dozing, 3 = high chance of dozing
Sitting and reading	
Watching TV	
Sitting inactive in a public place (e.g., a	

theater or a meeting)	
Riding as a passenger in a car for an hour without a break	
Lying down to rest in the afternoon when circumstances permit	
Sitting and talking to someone	
Sitting quietly after a lunch without alcohol	
Sitting in a car while stopped for a few minutes in traffic	
Score Results 1-6 Getting enough sleep: 4-8 Tends to be sleepy but is average: 9 and over Very sleepy and suggestive of sleep-disordered breathing. Patient should seek medical advice.	

WHAT ARE THE LIFESTYLE MEASURES AND MEDICATIONS USED FOR SLEEP APNEA?

Changes in Sleeping Habits

As a first step in dealing with sleep apnea, the patient should simply try rolling over onto the side. Patients who sleep on their backs and have 50 to 80 apneas (breathless events) per hour can sometimes reduce them to nearly zero when they shift to one side or the other. (The more overweight a person is the less effective changing positions is, but it still helps.)

Some suggestions that might help a person maintain a low-risk sleeping position are as follows:

- Sew a small pocket to the back of the pajamas and place a tennis or other small ball into it.
- A special pillow that helps to stretch the neck may reduce snoring and improve sleep for people with mild sleep apnea.

- One study suggested that sleeping in an upright position could improve oxygen levels in overweight people with sleep apnea. Elevating the head of the bed may help.

Nasal Strips

Over-the-counter nasal strips, such as the Breathe Right strip, or other devices that open the nostrils are inexpensive and useful to prevent snoring. They may significantly improve early-stage sleep in people with sleep disorders associated with nasal obstruction and help reduce morning tiredness. They are not intended as treatments for sleep apnea, however.

Weight Loss

All patients with obstructive sleep apnea who are overweight should attempt a weight-reducing program. Weight loss certainly reduces snoring in many people, sometimes stopping it completely. It also improves sleep and significantly reduces daytime sleepiness. One 2000 study suggested that people who lost 10% of body weight experienced an average 26% reduction in risk for developing sleep apnea in the first place. (Gaining 10% of their body weight, on the other hand, *increased* the odds of sleep apnea six-fold.) At the least, losing weight is certainly important for healthy blood pressure and for reducing the risk for diabetes. [For more information, see, *Obesity*.]

Smoking and Alcohol

- Smokers should quit, since smoking worsens apnea.
- Alcohol should be avoided within four hours of sleep.

Medications

In general, drugs have not been very beneficial except for specific situations. Using medications for treating accompanying disorders that may be associated with sleep apnea may be helpful. The following may be helpful for certain patients:

- Thyroid hormone may help sleep apnea in those with hypothyroidism.
- Theophylline, a drug commonly used for asthma management, has shown promise in treating central sleep apnea in patients with heart failure.
- Omeprazole (Prilosec), a drug used for patients with severe heartburn (gastroesophageal reflux disorder), may be helpful for patients with both problems.
- The drug modafinil (Provigil), which is showing promise for narcolepsy, may also be helpful for people with obstructive sleep apnea who are still sleepy after using continuous positive airway pressure (CPAP), the standard treatment for apneas. [See, *Narcolepsy*, for more information.]
- A nasal spray containing the steroid fluticasone improved breathing in a small 2001 study of children with obstructive sleep apnea due to enlarged tonsils and adenoids. (This approach wasn't as effective as surgical removal of these structures.)

Note on Sedatives. Sedatives, narcotics, and anti-anxiety drugs can actually worsen the breathing disturbances and arousal conditions that occur with sleep apnea. These substances cause the soft tissues in the throat to sag and diminish the body's ability to inhale. Apnea sufferers should stay away from sleeping pills and tranquilizers completely. Apnea patients undergoing surgery should be sure that their

surgeons, anesthesiologists, and other physicians are aware of their sleeping disorder in considering sedatives, anesthetics, and medications taken to relieve pain due to surgery.

WHAT ARE THE CONTINUOUS POSITIVE AIRFLOW PRESSURE (CPAP) DEVICES USED IN SLEEP APNEA?

Treatment for sleep apnea depends on the severity of the problem. Given data on the long-term complications of sleep apnea, it is important for patients to treat the problem as they would any chronic disease. Simply trying to treat snoring will not treat sleep apnea. Because of its association with heart problems and stroke, sleep apnea that does not respond to lifestyle measures should be treated by a physician, ideally a sleep disorders specialist.

At this time, the most effective treatments for sleep apnea are devices that deliver slightly pressurized air to keep the throat open during the night. There are a number of variations available.

Nasal Continuous Positive Airflow Pressure (CPAP)

Currently, the best treatment for severe obstructive and mixed sleep apnea is a system known as nasal continuous positive airflow pressure. It is safe and effective in sleep apnea patients of all ages, including children. It should be noted that patients with apnea but no daytime sleepiness report little or no benefit from CPAP, although it is still not known if CPAP has benefits on the heart regardless of its effect on sleepiness.

It works in the following way.

- The device itself is a machine weighing about five pounds that fits on a bedside table.
- A mask containing a tube connects to the device and fits over just the nose.
- The machine supplies a steady stream of air through a tube and applies sufficient air pressure to prevent the tissues from collapsing during sleep.

Effects on Sleep and Wakefulness. After using CPAP regularly many patients report the following benefits:

- Restoration of normal sleep patterns.
- Greater alertness and less daytime sleepiness.
- Less anxiety and depression and better mood.
- Improvements in work productivity.
- Better concentration and memory. (Some adults with symptoms of attention deficit hyperactivity disorder have improved after CPAP treatments for apnea.) In two studies, however, equal improvements were also observed in people on sham CPAP, suggesting that the actual cognitive benefits from CPAP may be modest.
- Patients' bed partners, too, report improvement in their own sleep when their mates use CPAP (even though objective sleep tests showed no real difference in the partners' sleep quality).

- Fewer accidents at work, at home, and in automobiles. A 2001 study, for example, reported that patients with apnea who were successfully treated with CPAP therapy were no more likely to have motor vehicle accidents than their non-apneic peers.

If patients do not experience less sleepiness after a period of time and are still complying with the regimen, then the airflow pressure may not be high enough. Patients may require retesting. It should be noted that many patients report feeling more alert after CPAP treatments even if objective laboratory tests fail to show significant differences in the number of apneas and wake-up periods.

- *Benefits on Health.* It is still not clear how significant the effects of CPAP are on health, including helping to prevent heart and circulation problems. Some studies have reported improvement in heart function and rate. Studies also report some benefits for serious conditions relating to the heart, such as hypertension and heart failure. A number of studies reported these effects as being generally modest to date.

Some studies suggest benefits on other aspects of health:

- Patients report fewer morning headaches.
- In some studies, patients have reported reduction in abdominal fat even if they failed to lose actual pounds. (Abdominal fat has been related to a higher risk for diabetes and heart disease.)
- In one case report, CPAP therapy halted progression of eye deterioration due to normal-pressure glaucoma. More research is warranted.
- CPAP may have some modest effects on the lungs in patients with both apnea and chronic obstructive lung disease (such as emphysema).
- Well-designed studies are underway to determine if CPAP can improve survival in patients with heart problems or other disorders associated with sleep apnea.

Side Effects and Getting Used to the Device. Unfortunately continuous positive airflow pressure (CPAP) devices are often cumbersome. All patients should be warned that the first few nights of CPAP therapy are unnerving:

- The device often produces anxiety, primarily because of the mask. Starting out with low pressure to get used to the mask may help.
- Patients may actually experience less sleep or sleep of a different quality in the beginning.

Nearly all patients complain about at least one side effect. Nearly half of complaints are related to the mask. Many can be alleviated with a well-chosen mask that is comfortable and reduces leakage as much as possible. In general complaints include the following:

- Irritation in the nose and throat. The most common complaints are nasal congestion and sore or dry mouth, which are caused by leakage that dries the airway. (This may be severe in elderly people or patients who have had uvulopalatopharyngoplasty, a surgical treatment for sleep apnea. Such patients are more likely to stop using CPAP.) Chin straps, nasal saline sprays, or humidifiers may prevent these side effects. Heated humidification devices are also now available for CPAP users.
- Excessive application of pressure making exhalation difficult.

- A feeling of claustrophobia is a major factor in noncompliance, which may be alleviated with a lightweight and transparent mask or with masks known as nasal pillows, which are used only around the nostrils.
- Up to 30% of patients experience irritation and sores over the bridge of the nose. Getting a properly fitted and cushioned mask can help reduce this effect.
- Eye irritation or conjunctivitis.
- Upper respiratory infections. It is very important to keep the unit clean.
- Patients may also experience chest muscle discomfort for a while, which is caused by an increase in lung volume.
- There have been reports of severe side effects, including heart rhythm disorders (arrhythmias), severe nose bleeding, and air pockets in the skull. These complications are very rare, however, and occur in only a few patients out of thousands.

Although studies have reported that long-term compliance with CPAP systems is low, with about one-third of patients giving up the treatment, recent information suggests that it is improving, probably due to better technology and better education. Patient education and support groups, a dedicated nurse to ensure close follow-up of patients (particularly in the first two weeks of therapy), and ready access to physicians to make adjustments as needed have all been shown to improve compliance greatly. Not surprisingly, patients whose symptoms are noticeably relieved by the procedure early on are more likely to continue the therapy.

Bilevel Positive Airway Pressure

Bilevel systems (e.g., BiPAP) appear to be particularly helpful for patients with coexisting lung disease and those with excessive levels of carbon dioxide. These devices have a sensing feature that helps determine and vary the appropriate pressure depending on whether a person is breathing in or out. Greater pressure is needed on inhalation and less on exhalation. (These machines are more expensive than the CPAP and may not be covered by insurance.)

Automatic Titrating (Auto)-CPAP Pressure Devices

Even more sophisticated systems are available called auto-CPAP devices, which use greater technological capacity to customize air pressure. They usually employ one of three methods:

- Overall pressure is kept low until a specific problem is detected. At that time the pressure is automatically increased rapidly.
- Pressure is low when there are no problems but is raised gradually when they are detected.
- Pressure is gradually raised and lowered in response to problems or their absence. In addition, the device can change depending on problems within single breaths.

Brands include AutoAdjust, Virtuoso, and AutoSet. These devices are more expensive than those that provide continuous airflow. And, in general, the pressure exerted using these devices is lower than with standard CPAP and there is little difference in effectiveness. These devices may improve compliance, however, in patients who find the steady flow of air from standard devices annoying or who require varying levels of pressure due to other conditions, such as seasonal allergies. They are also proving to be very useful as home diagnostic tools for sleep apnea. Auto-CPAP devices are not currently

recommended for all patients, however, including those with congestive heart failure or serious lung disease (e.g., chronic obstructive lung disease).

WHAT ARE THE DENTAL DEVICES USED TO TREAT SLEEP APNEA?

Mandibular Advancement Device (MAD) and Other Dental Products for Sleep Apnea

Several different dental appliances or treatments are available and are proving to be very valuable treatments for mild to moderate obstructive sleep apnea. Dentists and orthodontists are slowly becoming more aware of obstructive sleep apnea and may become more involved with its diagnosis and treatment. Among the devices available are the following examples:

- The mandibular advancement device (MAD) is the most widely used dental device for sleep apnea. It is similar in appearance to a sports mouth guard. MAD forces the lower jaw forward and down slightly, which keeps the airway open.
- Splints (e.g., Sleep Splint) are sometimes used that hold the tongue in a specific position to keep the airway as open as possible.
- The functional magnetic system uses it two magnets positioned on opposite sides of the jaw to keep the airway open.

Patients fitted with one of these devices should have a check-up early on to see if it is working; short-term success usually predicts long-term benefits. It may need to be adjusted or replaced periodically.

Benefits of Mandibular Advancement Device

Studies generally indicate satisfaction with the dental devices. MAD and similar devices seem to offer the following benefits:

- They reduce apneas significantly for those with mild to moderate apnea, particularly if patients sleep either on their backs or stomachs. (They are not as effective if the patient lies on his or her side.) They may also improve airflow, although less well, in those with severe apnea.
- They improve sleep in many patents.
- They improve and reduce the frequency of snoring and loudness of snoring in most (but not all) patients.
- Compliance rates are usually much higher than with CPAP.

In one 2002 report, long-term use of a dental device achieved an 81% success rate, which was significantly higher than the 53% success rate noted for uvulopalatopharyngoplasty (UPPP), the standard surgical treatment. There were also few complications with the dental device. Nevertheless, in an earlier study patients who used dental devices reported less contentment after one year of use than those who had had UPPP.

Disadvantages of Dental Devices

Dental devices, including MAD, are not as effective as CPAP therapy, but patients may be more satisfied with them. They do have side effects, however. For example, the following problems are reported with MAD devices:

- Side effects of MAD can include nighttime pain, dry lips, tooth discomfort, and excessive salivation. In general, these side effects are mild, although over the long term, nearly half of patients stop using them. Devices made of softer materials may produce fewer side effects.
- In some cases of long-term use, permanent changes in the position of the teeth or jaw have occurred. Periodic check-ups with a health professional are advised.
- The cost for these devices tends to be high (\$500 to \$2,000).
- In a small percentage of patients, the treatment may worsen apnea. Patients should be monitored with polysomnography before and after therapy.

Orthodontal Treatments

An orthodontic treatment called rapid maxillary expansion, in which a screw device is temporarily applied to the upper teeth and tightened regularly, may be beneficial for patients with sleep apnea and a narrow upper jaw. This nonsurgical procedure takes about three weeks and helps to reduce nasal pressure and improve breathing.

WHAT ARE THE SURGICAL PROCEDURES FOR SLEEP APNEA?

Surgery is sometimes recommended, usually by throat specialists. A patient should be sure to seek a second opinion from a specialist in sleep disorders. Few randomized clinical trials, the gold standard of medical research, have been conducted to verify the long-term efficacy of sleep apnea surgery.

Uvulopalatopharyngoplasty (UPPP)

The Procedure. Surgery known as uvulopalatopharyngoplasty (UPPP) removes soft tissue on the back of the throat. Such tissue includes all or part of the uvula (the soft flap of tissue that hangs down at the back of the mouth) and parts of the soft palate and the throat tissue behind it. If tonsils and adenoids are present, they are removed. The surgery typically requires a stay in the hospital.

The Goal of Surgery. The object of UPPP is threefold:

- To increase the width of the airway at the throat's opening.
- To block some of the muscle action in order to improve the ability of the airway to remain open.
- To "square off" the soft palate to improve its movement and closure.

Success Rates. Success rates for sleep apnea surgery are rarely higher than 65% and often deteriorate with time, averaging about 50% or less over the long term. Few studies have been conducted on the which patients make the best candidates. Some studies suggest that surgery is best suited for patients with abnormalities in the soft palate, which may or may not involve the tonsils. Results are poor if the problems involve other areas or the full palate. In such cases CPAP is superior. In one study, sleeping on the side (rather than the back) after surgery boosted success rates significantly.

Complications. Uvulopalatopharyngoplasty is among the most painful treatments for sleep apnea, and recovery takes several weeks. It is recommended only for select patients with severe obstructive sleep apnea. The procedure also has a number of potentially serious complications. In fact, in one study, 42% of patients had complaints about the procedure. Some complications include the following:

- Infection. (In one study this complication was so common that 40% of patients needed another operation because of it.) Preventive antibiotics administered an hour before surgery can help reduce this risk.
- Impaired function in the soft palate and muscles of the throat.
- Mucus in the throat.
- Changes in voice frequency.
- Swallowing problems.
- Regurgitation of fluids through the nose or mouth.
- Impaired sense of smell.
- Failure and recurrence of apnea. In such cases, continuous positive airway pressure (CPAP) is often less effective afterward, although one study found that oral appliances may still help.

In one review of studies, 20% of patients who had UPPP required tracheostomy afterward [*see below*]. Most of these complications can be avoided with proper technique and experienced surgeons. The use of lasers with UPPP is being investigated.

Laser-Assisted Uvulopalatoplasty (LAUP)

A variation on UPPP called laser-assisted uvulopalatoplasty (LAUP) is being increasingly performed to reduce snoring. It removes less tissue at the back of the throat than UPPP and can be done in a physician's office. At this time, however, long-term success rates from LAUP are less than 50%. Common complications include throat dryness (over 50%). Throat narrowing and scarring have been reported. In a minority of patients, snoring becomes worse afterward. There is also not enough evidence to determine if LAUP improves apnea at all. In fact, in one study, more than 30% of patients had worse breathing disturbance after LAUP. Some physicians are also concerned that if LAUP eliminates snoring, then a diagnosis of apnea may be missed in patients who have the more serious condition.

Tracheostomy

Tracheostomy used to be the only treatment for sleep apnea. It is quite straightforward:

- The surgeon makes an opening through the neck into the windpipe and inserts a tube.
- It is almost 100% successful, but it requires a quarter-size opening in the throat. This produces a number of medical and psychological problems associated with recovery.

Today, this is performed rarely, usually only if sleep apnea is life-threatening. A procedure that uses only a tiny opening may prove to be a good alternative.

Radiofrequency Ablation

A technique called radiofrequency ablation is of interest:

- It uses radio waves emitted from an electrode to treat patients who snore.
- The radio waves heat, stiffen, and shrink a small amount of tissue at the base of the tongue.
- The therapy takes about twenty minutes and can be done in a doctor's office.
- It typically requires 10 treatments within five or six sessions. (A newer form requires fewer treatment sessions because it provides more concentrated radio waves, and it appears to be effective.)
- It is far less invasive than standard surgery and results in far less pain and fewer complications. Discomfort can be controlled with simple pain relievers.

Studies are reporting significant improvement in reduced snoring and less daytime sleepiness for some patients, although as with other surgeries, the benefits may be short term in the majority of patients. It may be helpful for mild obstructive sleep apnea.

Other Surgical Procedures

Other surgical procedures may be appropriate to correct facial abnormalities or obstructions that cause sleep apnea. They may be used alone or combined with each other or with UPPP. They may include the following:

Tongue advancement, in which an opening is cut where the tongue joins the jawbone and the area is pulled forward.

Genioplasty, which is plastic surgery on the chin.

Hyoid surgery, in which the movable bone underneath the chin is moved forward, pulling the tongue muscle along with it.

Maxillary or maxillomandibular advancement (MMA), which moves the upper (maxilla) and/or lower (mandible) jawbone forward. (A survey of patients who had MMA found that the surgery changed their facial appearance, but most people thought it was a change for the better.)

Surgery for nasal obstructions (such as a deviated septum) that contribute to snoring and other symptoms.

Removing Adenoids and Tonsils in Children

Adenotonsillectomy, or surgical removal of the tonsils and adenoids, is a first-line treatment for children and adolescents with sleep apnea. It cures the condition in 75% to 100% of cases, including in children who are obese. Complications include respiratory illness, which occurs in about one-fourth of children after the surgery. The procedure may fail to improve apnea in some patients, such as those with very severe disease. Such children are candidates for continuous positive airway pressure (CPAP) therapy.

Removal of the tonsils and adenoids alone is not an effective treatment for adults with sleep apnea, although the procedure may be effective when combined with UPPP surgery.

Investigative Approaches

Hypoglossal Nerve Stimulation. In a small study, a small implantable electrical device that stimulates the hypoglossal nerve, which is under the tongue, during inspiration eased symptoms of obstructive sleep apnea. Further testing of this experimental technique is needed.

Speeding up Pacemakers. One intriguing 2002 study of people with sleep apnea and who had pacemakers found that when the pacemakers were increased to 15 beats per minute faster than the average nighttime rate patients reported improvement in sleep apnea. Some experts theorize that sleep apnea in patients with slow heart rates may be due to common problems in the nerves that affect the muscles in the heart and the throat. It is possible that drugs that increase heart rate may prove a novel method for treating the disorder, though further study is needed.

WHERE ELSE CAN HELP FOR SLEEP APNEA BE OBTAINED?

American Sleep Apnea Association, 1424 K Street NW, Suite 302, Washington, DC 20005. Call (202-293-3650) or (<http://www.sleepapnea.org>). This is an excellent organization; it offers the newsletter Wake-up Call, provides a national network of about 150 support groups known as the Awake Network, and offers a medical-alert bracelet. This group offers emotional support and is very helpful in encouraging CPAP compliance.

American Academy of Sleep Medicine, One Westbrook Corporate Center, Ste. 920, Westchester, IL 60514. Call (708-492-0930) or (<http://www.aasmnet.org>). Gives all accredited sleep disorder centers. This is a professional organization for physicians, but they will provide a full list of accredited Sleep Disorders Clinics. They publish the journal Sleep.

National Sleep Foundation, 1522 K Street, NW, Suite 500, Washington, D.C. 20005. Call (202-347-3471) or (<http://www.sleepfoundation.org>). Will supply names of sleep disorders clinics and information to the public.

National Center on Sleep Disorders Research

Two Rockledge Centre Suite 10038, 6701 Rockledge Drive MSC 7920, Bethesda, MD 20892. Call (301-435-0199) or (<http://www.nhlbi.nih.gov/about/ncsdr/index.htm>)

For children with sleep apnea :

Kids-ENT.com, a Web site for parents at <http://www.kids-ent.com/tonsil.html#why>

The Garfield the Cat Star Sleeper at <http://starsleep.nhlbi.nih.gov/>

Websites that sell CPAP supplies

(Note: These have not been reviewed by our editors and we cannot vouch for their quality)

<http://www.cpapplus.com/>

<http://www.sleepquest.com/>

<http://www.owt.com/conjo/>

Good Internet Sites

UCLA Sleep Home Page (<http://www.sleephomepages.org/>) Has a searchable database with articles on all sleep topics.

The Sleep Well (<http://www.stanford.edu/~dement/>) This is a very good site filled with information

NAPS (<http://www.websciences.org/bibliosleep/naps/>)

World Federation of Sleep Research Societies (<http://www.wfsrs.org/newsletter.html>)

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