The Laryngoscope
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Contemporary Review

Sleep Medicine for Surgeons

Terence M. Davidson, MD

Sleep medicine is an important component of current head and neck surgery practices. Furthermore, obstructive sleep apnea is an anatomic disease of the upper respiratory tract, a region of anatomy best known to head and neck surgeons. If head and neck surgeons choose to participate in the surgical treatment of sleep apnea, they must develop expertise in the evaluation and home sleep testing aspects of sleep apnea. Because positive airway pressure remains the front line treatment, they must also develop expertise in the prescription of positive airway pressure therapy.

Key Words: Sleep apnea, obstructive, sleep disordered breathing, continuous positive airway pressure.

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INTRODUCTION

Surgeons wanting to actively participate in sleep medicine and the care of patients with sleep apnea will need to know about diagnosis and testing, and all forms of treatment, both medical and surgical. Two models exist for surgical specialties. One is a practice made up of companion medical specialties. Examples of such are cardiology and cardiac surgery, pulmonary medicine and thoracic surgery, and gastroenterology and general surgery. The second model is the surgical specialty that combines medical and surgical practices. Otolaryngology is one example and ophthalmology another. Although one can raise a cogent argument for using a balanced, two-specialty approach, this has its complexities. The medical specialty may develop its own therapies. Cardiology certainly invaded the practice of coronary artery surgery with its practice of angioplasty and coronary stenting. Surgeons used to perform skin cancer surgery. Dermatology, the diagnostic specialty, now performs many of these procedures. Several years ago, allergy and immunology attempted to take over the management of rhinologic disease. Head and neck surgeons protested and now serve as the primary manager of rhinologic illness. Audiologists keep pushing to expand their scope of practice. Speech pathologists do the same, as do oral surgeons. Head and neck surgery opposes these intrusions, arguing it is bad for the patient and bad for the specialty.

All this is true for sleep medicine as well. Pulmonologists, psychiatrists, and neurologists now diagnose and treat patients with sleep apnea. This is most interesting because sleep apnea is a disease of the upper respiratory tract (URT). These specialties have all identified sleep apnea as an important addition to their practice. This is perplexing because these specialties have little ability to examine the URT and virtually no ability to surgically modify the URT. Their major interest is diagnosis through polysomnography (PSG). These practitioners strive to be the gatekeeper of all diagnoses and treatments and, generally speaking, refer few patients to head and neck surgery for evaluation and treatment.[1]

It is, therefore, absolutely, imperatively critical that head and neck surgery assume greater responsibility for the diagnosis and treatment of this morbid, mortal, URT illness. This paper discusses the important components of head and neck surgery sleep medicine practice.

Kryger's Textbook of Sleep Medicine lists 76 different diagnoses for sleep disorders (Fig. 1).[2] Table I provides the American Board of Sleep Medicine's Examination Blueprint. The percentages given in the table reflect the relative importance of each area during the board examination. Obstructive sleep apnea (OSA) is the most common diagnosis, second only to insomnia. Overlapping terms exist. Sleep disordered breathing (SDB), for example, includes snoring, upper airway resistance syndrome (UARS), OSA, hypoventilation with obesity, and central sleep apnea. The International Statistical Classification of Diseases and Related Health Problems-(ICD-9) codes for sleep disorders most commonly used in head and neck surgery are given in Table II.

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The International Classification of Sleep Disorders

	Recommended ICD-9-CM#		Recommended ICD-9-CM#
Dyssomnias		**Parasomnias** ***Continued***	
Intrinsic sleep disorders		***Other parasomnias***	
Psychophysiological insomnia	307.42-0	Sleep Bruxism	306.8
Sleep state misperception	307.49-1	Sleep enuresis	780.56-0
Idiopathic insomnia	780.52-7	Sleep-related abnormal swallowing syndrome	780.56-6
Narcolepsy	347		
Recurrent hypersomnia	780.54-2	Nocturnal paroxysmal dystonia	780.59-1
Idiopathic hypersomnia	780.54-7	Sudden unexplained nocturnal death syndrome	780.59-3
Post-traumatic hypersomnia	780.54-8		
Obstructive sleep apnea syndrome	780.53-0	Primary snoring	780.53-1
Central sleep apnea syndrome	780.51-0	Infant sleep apnea	770.80
Central alveolar hypoventilation syndrome	780.51-1	Congential central hypoventilation syndrome	770.81
Periodic limb movement disorder	780.52-4	Sudden infant death syndrome	798.0
Restless legs syndrome	780.52-5	Benign neonatal sleep myoclonus	780.59-5
Intrinsic sleep disorder NOS	780.52-9	Other parasomnia NOS	780.59-9
Extrinsic sleep disorders		**Sleep Disorders Associated with Medical or Psychiatric Disorders**	
Inadequate sleep hygiene	307.41-1		
Environmental sleep disorder	780.52-6	***Associated with mental disorders***	290-319
Altitude insomnia	993.2	Psychoses	292-299
Adjustment sleep disorder	307.41-0	Mood disorders	296-301
Insufficient sleep syndrome	307.49-4	Anxiety disorders	300
Limit-setting sleep disorder	307.42-4	Panic disorder	300
Sleep-onset association disorder	307.42-5	Alcoholism	303
Food allergy insomnia	780.52-2	***Associated with neurological disorders***	320-389
Nocturnal eating (drinking) syndrome	780.52-8	Cerebral degenerative disorders	330-337
Hypnotic-dependent sleep disorder	780.52-0	Dementia	331
Stimulant-dependent sleep disorder	780.52-1	Parkinsonism	332-333
Alcohol-dependent sleep disorder	780.52-3	Fatal familial insomnia	337.9
Toxin-induced sleep disorder	780.54-6	Sleep-related epilepsy	345
Extrinsic sleep disorder NOS	780.52-9	Electrical status epilepticus of sleep	345.8
		Sleep-related headaches	346
Circadian rhythm sleep disorders		***Associated with other medical disorders***	
Time-zone change (jet lag) syndrome	307.45-0	Sleeping sickness	086
Shift work sleep disorder	307.45-1	Nocturnal cardiac ischemia	411-414
Irregular sleep-wake pattern	307.45-3	Chronic obstructive pulmonary disease	490-494
Delayed sleep phase syndrome	780.55-0	Sleep-related asthma	493
Advanced sleep phase syndrome	780.55-1	Sleep-related gastroesophageal reflux	530.1
Non-24-hour sleep-wake disorder	780.55-2	Peptic ulcer disease	531-534
Circadian rhythm sleep disorder NOS	780.55-9	Fibrositis syndrome	729.1
Parasomnias		**Proposed Sleep Disorders**	
Arousal disorders		Short sleeper	307.49-0
Confusional arousals	307.46-2	Long sleeper	307.49-2
Sleepwalking	307.46-0	Subwakefulness syndrome	307.47-1
Sleep terrors	307.46-1	Fragmentary myoclonus	780.59-7
Sleep-wake transition disorders		Sleep hyperhidrosis	780.8
Rhythmic movement disorder	307.3	Menstrual-associated sleep disorder	780.54-3
Sleep starts	307.47-2	Pregnancy-associated sleep disorder	780.59-6
Sleeptalking	307.47-3	Terrifying hypnagogic hallucinations	307.47-4
Nocturnal leg cramps	729.82	Sleep-related neurogenic tachypnea	780.53-2
Parasomnias usually associated with REM sleep		Sleep-related laryngospasm	780.59-4
		Sleep choking syndrome	307.42-1
Nightmares	307.47-0		
Sleep paralysis	780.56-2		
Impaired sleep-related penile erections	780.56-3		
Sleep-related painful erections	780.56-4		
REM sleep-related sinus arrest	780.56-8		
REM sleep behavior disorders	780.59-0		

From the American Sleep Disorders Association, Diagnostic Classification Steering Committee; MJ Thorpy, Chairman. International Classification of Sleep Disorders: Diagnostic and Coding Manual. Rochester, MN, American Sleep Disorders Association, 1990. NOS, Not otherwise specified.

Fig. 1. *Kryger's Textbook of Sleep Medicine* offers a list of 76 different diagnoses for sleep disorders.

TABLE I.
Sleep Medicine Examination Blueprint.

- Normal sleep and variants (13%)
  - Sleep-wake mechanisms, neurophysiology
  - Chronobiology/neurophysiology
    - Circadian timing
    - Homeostatic sleep regulation
  - Sleep at different ages/stages of human life
    - Infancy
    - Childhood
    - Adolescence
    - Adulthood
    - Elder years
    - Pregnancy
    - Menopause
  - Effects of sleep deprivation
    - Neurobehavioral function
    - Learning and school performance
    - Mood disturbances
    - Metabolic disturbances
- Organ system physiology in sleep (5%)
  - Respiratory
    - Control of breathing
    - Airway reflexes
    - Blood gases
    - Pulmonary function
    - Oxyhemoglobin dissociation curve
    - Effects of sleep state
  - Other systems
    - Cardiovascular
    - Endocrine
    - Gastrointestinal
    - Hematologic
    - Immunologic
- Sleep evaluation (20%)
  - Sleep history and physical examination
  - Polysomnography and electroencephalography
    - Techniques and safety measures
    - Digital data acquisition and display
    - Waveform recognition
    - Artifacts
    - Arrhythmias
    - Seizures
    - Expanded electroencephalogram montage
  - Sleep staging and scoring
    - Arousals
    - Periodic limb movements
    - Respiratory events
    - Staging across the lifespan
  - Multiple sleep latency and maintenance of wakefulness tests
    - Indications
    - Protocol
    - Interpretation
    - Scoring and limitations
    - Sensitivity/specificity
  - Other techniques
    - Actigraphy
    - Pulse oximetry
    - Sleep logs
    - Psychometrics
    - Esophageal pH testing
    - PCO_2 monitoring
- Pharmacology (7%)
  - Basic sleep-wake pharmacology
  - Drugs/agents affecting sleep and wakefulness
    - Benzodiazepine receptor agonists and other hypnotic agents
    - Melatonin and melatonin agonists
    - Anticataleptics
    - Antihypertensive agents
    - Antidepressants and other psychotropic agents
    - Alcohol
    - Caffeine
    - Narcotics
    - Stimulants
    - Naturopathic agents
    - Illicit drugs and chemicals of abuse
- Disorders related to sleep-wake timing, including epidemiology, pathophysiology, diagnosis, and management (5%)
  - Circadian sleep disorders
    - Delayed sleep phase
    - Advanced sleep phase
    - Free-running (nonentrained)
    - Irregular sleep-wake rhythm
  - Shift work
  - Jet lag
  - Other, including disruption related to behavior, medical conditions, or drugs/substances
- Insomnia, including epidemiology, pathyphysiology, diagnosis, and management (10%)
  - Adjustment insomnia
  - Psychophysiologic insomnia
  - Paradoxical insomnia
  - Insomnia caused by mental disorder
  - Idiopathic insomnia
  - Inadequate sleep hygiene
  - Other, including insomnia related to behavior, medical conditions, or drugs/substances
- Hypersomnolence unrelated to sleep-related breathing disorders, including epidemiology, pathophysiology, diagnosis, and management (7%)
  - Narcolepsy with/without cataplexy
  - Cataplexy
  - Psychiatric disorders
  - Recurrent hypersomnia, including Kleine-Levin syndrome
  - Idiopathic hypersomnia
  - Insufficient sleep syndrome
  - Post-traumatic hypersomnia
- Parasomnias, including epidemiology, pathophysiology, diagnosis, and management (4%)
  - Sleepwalking
  - Sleep terrors
  - REM sleep behavior disorder
  - Confusional arousals
  - Enuresis

(*Continues*)

TABLE I.
(*Continued*).

Sleep-related movement disorders, including epidemiology, pathophysiology, diagnosis, and management (5%)
Restless legs syndrome
Periodic limb movement disorder
Rhythmic movement disorder
Bruxism
Sleep-related breathing disorders, including epidemiology, pathophysiology, diagnosis, and management (17%)
Obstructive sleep apnea
Risk factors
Genetic factors
Diagnostic issues
Comorbid conditions
Central sleep apnea
Cheyne-Stokes respiration
Periodic breathing at high altitude
Idiopathic central apnea
Primary sleep apnea of childhood
Sleep-related hypoventilation/hypoxemic syndromes
Congenital hypoventilation syndromes
Acquired hypoventilation syndromes
Neuromuscular and pulmonary disorders
Treatment
Positive airway pressure
Surgery
Oral appliances
Behavioral techniques
Sleep in other disorders (5%)
Neurologic
Neurodegenerative and neuromuscular disorders
Cerebrovascular disorders
Seizure disorders
Congenital disorders
Headaches
Psychiatric
Mood disorders
Psychotic disorders
Anxiety
Substance abuse
Other medical disorders
Genetic conditions
Endocrine disorders
Cardiac disorders
Considerations and disorders unique to childhood (2%)
Safe infant sleep
Behavioral insomnia of childhood
Infant apnea
Sleep-onset association disorder
Apparent life-threatening events

TABLE II.
ICD-9 Codes for Sleep Related Breathing Disorders Most Commonly Used at University of California, San Diego Head and Neck Surgery Sleep Clinic.

Diagnosis Description	ICD-9
Obesity, unspecified	278.00
Sleepwalking/sleep terror	307.46
Organic sleep apnea, unspecified	327.20
Primary central sleep apnea	327.21
Central Sleep caused by high-altitude periodic breathing	327.22
Obstructive sleep apnea, adult and pediatric	327.23
Sleep related nonobstructive alveolar	327.24
Hypoventilation, idiopathic	
Central sleep apnea caused by medical condition	327.27
Central sleep apnea due to drug or substance	327.29
Periodic limb movement disorder	327.51
Narcolepsy w/ cataplexy	347.01
Narcolepsy w/o cataplexy	347.00
Somnolence	780.09
Sleep disturbance, unspecified	780.50
Insomnia w/ sleep apnea, unspecified	780.51
Insomnia, unspecified	780.52
Sleep apnea, unspecified	780.57
Sleep related movement disorder, unspecified	780.58
Sleep disturbances, other	780.59
Apnea	786.03
Cheyne-Stokes breathing pattern	786.04
Enuresis	788.30
Nocturia	788.43

The head and neck surgeon should present him or herself as skilled and interested in the full spectrum of SDB symptoms, the primary and premier symptom being snoring. Referral by primary care physicians (PCP) should be nurtured by recommending that the PCP ask patients about sleep, snoring, apneic episodes, and daytime sleepiness. Those patients with significant snoring, meaning that it occurs most nights, should be referred for evaluation. Those with apneic episodes and daytime sleepiness not otherwise explained should also be referred. Table III provides a list of SDB comorbidities and their SDB prevalence. Patients with these comorbid conditions should always be queried regarding snoring and, if it is present, recommended for referral. Head and neck surgeons need not be expert in other sleep diagnoses, and these patients can be referred to our sleep medicine colleagues for evaluation and management.

The head and neck surgeon may want to take some interest in insomnia. As referring physicians become increasingly comfortable referring snoring patients, they will soon begin referring all sleep problems. The occasional case of narcolepsy or other sleep abnormality is easily discerned and can be referred to the appropriate physicians. However, insomniacs present with daytime sleepiness. PCPs do poorly with diagnosing insomnia and sometimes wonder whether it might be SDB. Or, they may just not know how to treat it. Therefore, the insomniac patients will occasionally be referred to the head and neck surgeon. As with every aspect of the business, referral is everything. To keep the referring PCP happy, it is suggested that the head and neck surgeon help care for a few

TABLE III.
Medical Conditions Associated with Sleep Disordered Breathing (SDB) and Prevalence of Their Association with SDB.

Category	Condition	Percent	References
Cardiac	Hypertension	30	37
	Drug-Resistant hypertension	83	38
	Congestive heart failure	76	39
	Ischemic heart disease	38	40
	Dysrhythmias	58	41
	Atrial fibrillation	49	42
Respiratory	Pulmonary hypertension	77	43
	Asthma	18	44
Neurologic	Stroke	90	45
Metabolic	Type II diabetes	15	46
	Metabolic syndrome	50	47
	Morbid obesity (male)	90	48
	Morbid obesity (female)	50	
Gastrointestinal	Gastroesophageal reflux disease	60	49
Genitourinary	Nocturia	48	50
Motor vehicle accidents		7× normal	51
Daytime sleepiness		87	52

of these patients. Insomnia in this regard will be discussed below.

HISTORY AND PHYSICAL EXAMINATION

Evaluation begins with history taking and physical examination. At the University of California, San Diego Head and Neck Surgery Sleep Medicine Clinic, we use a standard intake form, as shown in Figure 2.[3] Nurses collect most of this information. Age, sex, height, weight, and body mass index (BMI) are obvious data to collect. Waist and neck circumference, BMI, and waist hip ratio are all important measures of central obesity, also known as visceral adiposity and intra-abdominal adiposity.[4] Waist circumference is a better indicator of SDB and cardiovascular disease than BMI. We record both but prefer waist circumference as the single most important measure of central obesity.

Determining comorbidity with the list seen in Table III is an important piece of the evaluation. Presence of comorbidity emphasizes the undesired consequences of untreated SDB. Medicare guidelines support treatment for patients with an apnea-hypopnea index (AHI) of 15 or more or an AHI of 5 or more with two or more comorbidities.

The sleep habits of the patient are important. It is difficult to improve daytime sleepiness in those with poor sleep hygiene and insufficient sleep time. Caffeine, nicotine, and alcohol all interfere with normal sleep. SDB and insomnia are a bad combination. SDB and chronic obstructive pulmonary disease are also a bad combination. It is best to know about the presence of these factors up front before recommending treatment. Drugs and disease all interfere with sleep. One should know as much as possible about these interactions.

The physical examination is controversial as many report it differently. Nasal polyps, presence of four or more tonsils, and oropharyngeal neoplasms are three findings easily made, and each lead to obvious treatment and, very often, resolution of SDB.

However, the majority of patients have nighttime obstruction in an airway that is examined while the patient is awake. At a minimum, examination includes anterior rhinoscopy, direct examination of the mouth and oropharynx, and flexible transnasal pharyngeal-laryngeal endoscopy. Although these are not performed by every sleep physician, head and neck surgeons are skilled at this examination and may find tumors, enlarged adenoids, lingual tonsils, an abnormal epiglottis, and laryngomalacia and can help identify narrowing in the retrolingual oropharynx. There are many other possible pertinent findings. These findings can be important in identifying surgical candidates. Each physician can develop his or her own measurement criteria. Those used in San Diego are shown in Figure 2B. I do not find the grading system very satisfying and, other than grade 4 obstruction, find it difficult to translate these scores into surgical decision-making. Nonetheless, one has to examine the patients, quantify the physical findings, and consider them in treatment recommendations.

Tonsillectomy and adenoidectomy is an excellent treatment, with a 90% success rate in pediatric SDB.[5] Presence of four plus tonsils certainly warrants consideration for surgery in adults. However, tonsillectomy for all patients has not enjoyed the success found in pediatric SDB. Most medical sleep physicians do not examine or grade the tonsils, an omission I find substantial.

In 1985, Mallampati, a Harvard anesthesiologist, described an oropharyngeal grading system to help predict difficult intubation.[6] In anesthesia, most Mallampati scores are 1 or 2, and grades 3 and 4 are associated with difficult intubation.[7,8] The standard grading system is shown in Figure 2B. Different people derive the Mallampati score differently. Anesthesiologists are interested in how easily the tongue is lifted out of the pharynx at laryngoscopy. They make their measurements with the tongue protruded, the patient phonating "ah," one of the few sounds one can make with an open mouth and protruding tongue. "Ah" tenses and flattens the tongue and raises the soft palate.

The head and neck surgeon is interested in the flaccid/relaxed tongue of deep sleep. Typically, the patient is simply instructed to open the mouth with no tongue protrusion and no phonation.

The Mallampati score in SDB generally differs from the tongue protrusion, phonation score by at least 1 full point. Performing the examination the same way each time is important. Friedman et al.[9] reported their results with uvulopalatopharyngoplasty. They found better results with patients whose Mallampati scores were 1 and 2 and poorer results in patients with higher Mallampati scores.

A

UNIVERSITY of CALIFORNIA, SAN DIEGO
MEDICAL CENTER

SLEEP DISORDERED BREATHING

Name
MR#
DOB

Source Date

Patient Identification

Referring Physician _____

AGE	GENDER	HEIGHT	WEIGHT	BMI	Neck Circ.	BP	WHR
	☐M ☐F	cm	kg	kg/M²	inches		

Snoring: intensity (0-3) _____ frequency (0-3) _____ Apneic episodes (0-3) _____ Daytime sleepiness (0-4) _____

Co-Morbidities

Yes	No			Yes	No
☐	☐	Hypertension	Heart Failure	☐	☐
☐	☐	Obesity	Diabetes	☐	☐
☐	☐	Excessive daytime sleepiness	GERD	☐	☐
☐	☐	Coronary artery disease/MI	Asthma	☐	☐
☐	☐	Stroke	Parasomnias	☐	☐
☐	☐	Atrial fibrillation	# MVAs (in past 10 yrs.)		☐

Meds:

_____
_____
_____
_____
_____

Depression ☐ Yes ☐ No

NYHA Class _____ (I-IV)

Alcohol _____ (glasses/night)
Time to bed _____

Insomnia ☐ Yes ☐ No
Time out of bed _____

Nocturia _____ x per night
Total bed time _____ hrs

Examination *(See back for details)*

Nose (0-4) _____
Mallampati (1-4) _____
Endoscopy: Tongue base (1-4) _____
Lingual Tonsil (1-4) _____
Thyromental distance _____ cm

Uvula (0-4) _____
Tonsils (0-4) _____
Epiglottis (0,1) _____
SNB _____ degrees

Other:

CT/MRI _____
_____
_____

Pre Sleep Test Impression: ☐ Insomnia 780·52 ☐ SDB 780·57 ☐ OSA 327·23 ☐ EDS 327·8

Plan: _____

Physician Signature/PID _____ Date _____

Sleep Test date _____ Total sleep time _____ AHI _____ AI _____
0_2 desat Index _____ LSAT _____
CPAP 95th pressure _____ cm H_20
APAP Mean pressure _____ cm H_20 Mask _____
DME _____
Compliance: Days/week _____ Hrs/day _____

Post Sleep Test
Other therapies and follow-up

D1515 (12-06)

Physician Signature/PID# Date & Time

Fig. 2. (A) Standard intake form for sleep disordered breathing used in Head and Neck Surgery Sleep Medicine Clinic to take history and physical examination. (B) History and physical examination uses scaled scores for upper respiratory tract evaluation and sleep and medical history.

B

Snoring Sleep Examination

Snoring		Apneic Episodes	Daytime Sleepiness
Intensity	Frequency		
0 = None	0 = None	0 = None	0 = Never
1 = Mild/bedroom	1 = Occasional 1-2 d/wk	1 = 1 or 2/night	1 = Only after meals
2 = Moderate/house	2 = Frequent 3-5 d/wk	2 = 2-10/night	2 = Most days, but do not fall asleep
3 = Severe/yard	3 = Daily 6 or 7 d/wk	3 = 10 or more/night	3 = Occasionally fall asleep
			4 = Regularly fall asleep

Upper Respiratory Tract Sleep Examination

Nose 0-4
0 Post-op perfectly straight
1 Straight with normal cartilage/bone at floor <10% obstruction
2 10-50% obstruction worst side
3 50-90% obstruction worst side
4 90-100% obstruction worst side or obstructive nasal polyps. Allergic rhinitis- add one. Total not to exceed 4.

Mallampati 1-4
1 All of uvula and tonsils/pillars
2 Partial uvula and partial tonsils/pillars
3 Base of uvula
4 No uvula

Tonsil 0-4
0 S/P tonsillectomy
1 Inside the pillars
2 Outside the pillars, <25% of airway
3 25% - <75% of airway
4 75% or more of airway

Adenoids 0-4
0 Postop
1 <10% obst
2 10-50%
3 50-90%
4 >90%

Uvula 0-4
0 Absent
1 U<50 mm² (5 x 10mm)
2 50>U<112.5mm² (7.5 x 15mm)
3 112.5>U<200mm² (10 x 20mm)
4 200>U

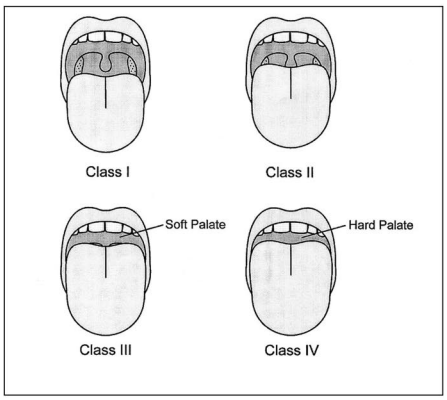
Tongue 1-4

(F.O.E.), patient sitting, mouth closed
1 Vallecula open
2 Vallecula filled with tongue base
3 Epiglottis pushed posteriorly
4 Epiglottis touching post pharyngeal wall secondary to tongue base pressure

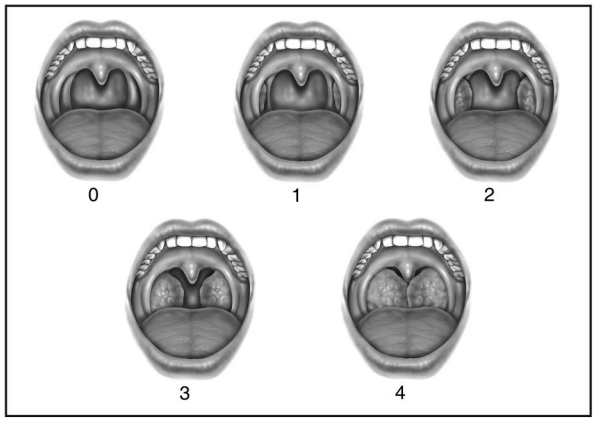
Larynx 0,1 (F.O.E.)
0 Normal
1 Any airway obstruction or deformed epiglottis, not covered above.

Lingual Tonsils 1-4
1 None
2 Small
3 Medium
4 Large

Mallampati



Tonsil Grade



Waist Hip Ratio (WHR)					
	acceptable		unacceptable		
	excellent	good	average	high	extreme
male	<0.85	0.85-0.9	0.9 0.95	0.95-1	>1
female	<0.75	0.75-0.8	0.8-0.85	0.85-0.9	>0.9

Depression: Yes = affirmative answer to #1 or #2
1) Over the past 2 weeks have you ever felt down, depressed, or hopeless?
2) Over the past 2 weeks, have you felt little pressure or interest in doing things?*
(Sensitivity 96%; Specificity 57%)*

NYHA: New York Heart Association Class
Class I - Asymptomatic
Class II - Symptomatic with moderate exertion
Class III - Symptomatic with little exertion
Class IV - Symptomatic at rest

*MP Pignone, et al: Screening for Depression in Adults: A Summary of the Evidence for the U.S. Preventive Services Task Force, Ann Intern Med 2002 136:765-776

D1515 (12-06) Page 2 of 2

Fig. 2. (*Continued*).

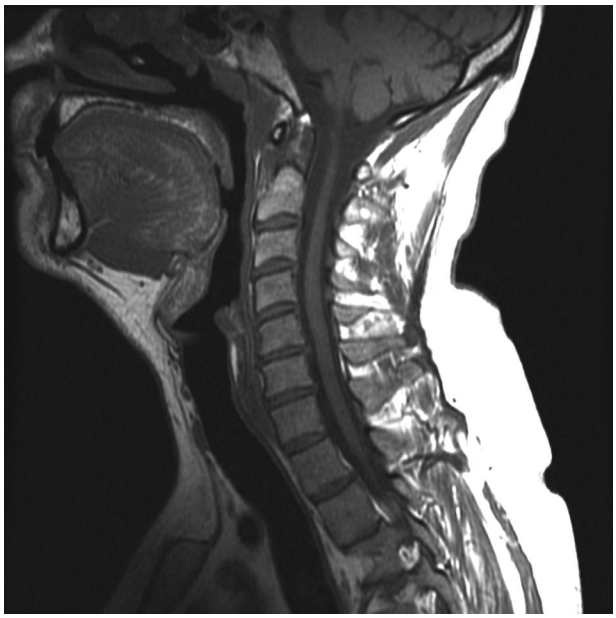


Fig. 3. Mid-sagital T2 magnetic resonance image of 50-year-old male with a body mass index of 24.

The anatomy of the patient with abnormal Mallampati score has never been described. The cause can be a small mandibular arch, short mandible, high mylohyoid floor of mouth, low palate, acute cranial base angulation, a large tongue, or some other explanation. Figure 3 shows a mid-sagittal T2 magnetic resonance imaging scan of a 50-year-old male with a BMI of 24. Although it may not answer the question "What is the anatomy of SDB?", it certainly contains the anatomic elements. We currently believe that Mallampati scores correlate with obesity, especially in men, although less so in women. The posterior tongue contains large amounts of fat, up to 40%.[10] Tongue volume increases with patient size and obesity. We currently believe that Mallampati score correlates with a composite of mandibular size, tongue volume, laryngeal descent, and obesity. High Mallampati score predicts poor treatment results of SDB in nasal and palatal procedures. Analysis of the score also confirms our belief that the tongue is the main obstruction in SDB, and we are still looking for an effective procedure to alleviate nighttime tongue obstruction.

The anatomy of SDB is best understood from an evolutionary perspective. This is described in a paper titled "The Great Leap Forward."[11] The URT evolved over the past 250,000 years to facilitate speech. The requisite anatomic changes created a URT prone to nighttime collapse. Understanding these changes is important to the surgeon to evaluate and treat the URT.

Before proceeding to a discussion of sleep testing, we should ask, what is SDB and why do we treat it? Snoring that disrupts a bed partner certainly warrants treatment to reduce the disruption and improve bedroom harmony. Does snoring affect physiology? This certainly occurs as snoring progresses to obstruction. Some have opined that snoring creates a vibration at the carotid bifurcation and leads to carotid artery plaque development.[12] Some believe that any breathing disruption creates sympathetic neural activation (SNA). The classic work of Virend Somers et al.,[13] from which Figure 4 is taken, discussed a nighttime increase in blood pressure. At some point in the progression of airflow restriction, cerebral arousal occurs and the cardiovascular system becomes impacted.

Hypertension has a high association with SDB, 30% for all forms of hypertension and 80% for drug-resistant hypertension (Table III). The author believes it develops from SNA. Cardiovascular disease begins to develop and progresses through a cascade of angina, myocardial infarction, stroke, arrhythmia, and death. Arousals interrupt normal sleep, and daytime sleepiness develops. Mental lapses result in motor vehicle and other accidents. Quality of life deteriorates. Work performance decreases. Exercise decreases. Poor dietary habits develop, and patients gain weight, further obstructing their nighttime breathing and accelerating the progression of SDB.

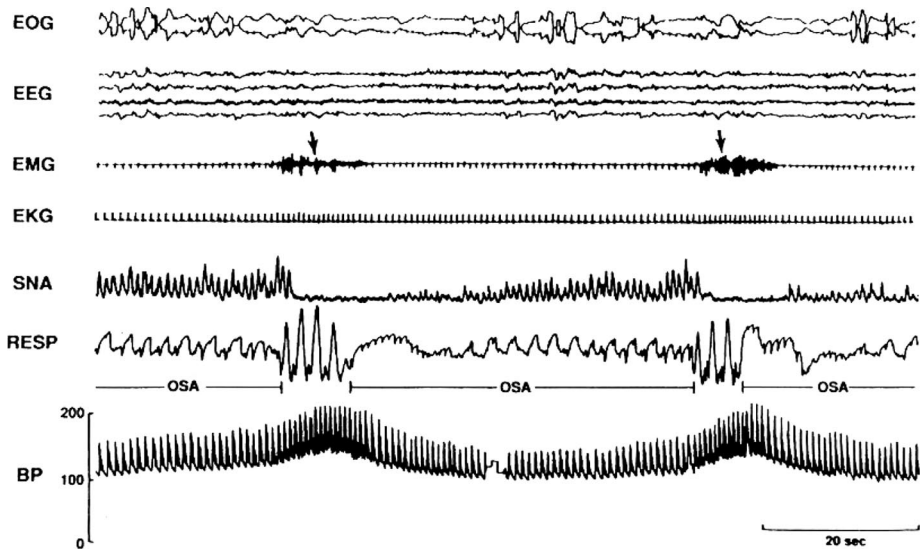


Fig. 4. Superimposed recordings of electrooculogram (EOG), electroencephalogram (EEG), electromyogram (EMG), electrocardiogram (EKG), sympathetic nerve activity (SNA), respiration (RESP), and blood pressure (BP) during REM sleep in patient with OSA. From Somers et al.[13] All rights reserved. Reproduced with permission.

Sex differences are important. Age differences are also important. The author's observations are summarized in the following paragraphs. Others may have different observations, and generalizations can be overly broad. Children with SDB have behavior problems.[14] They are hyperactive and inattentive. Young adults rarely talk of daytime sleepiness. However, once treated, they have greater energy and improved peace and tranquility in their lives.

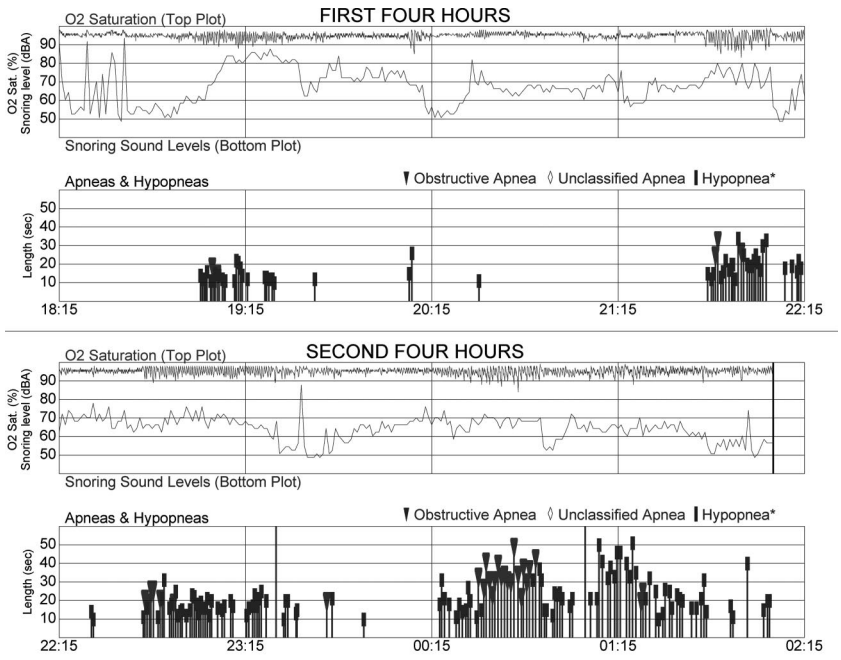
The adult male typically begins his SDB with snoring and will not show other symptoms such as daytime sleepiness until their mid 40s. I believe they suffer from fatigue but do not know it and therefore do not report it. As men age, they begin to suffer and complain of daytime sleepiness.

Women with SDB are different. They complain of sleepiness and lack of energy. They tend to somatasize symptoms, which are often confused with depression and thus treated with antidepressants. Postmenopausal women behave like their male counterparts. Premenopausal women should be divided into those who are pre- and postparturition.

Prior to childbirth, young women typically sleep soundly. Childrearing can create light sleepers, that is, a woman always vigilant for her baby's cry. Once child rearing passes, they remain light sleepers and, before menopause, suffer cortical arousals with even mild respiratory obstruction. A young woman's sleep appears to be more easily interrupted than a young male's. Even with a low AHI, women benefit from treatment. UARS is more commonly diagnosed in women than in men, which further supports these thoughts. Women are more likely to complain of somatic problems. In general, they are hard workers and light sleepers. These can be difficult cases to diagnose and difficult cases to treat. Pregnancy is also associated with SDB.[15] Preeclampsia is highly associated with SDB.[16] Causality has not been demonstrated.

SLEEP TESTING

The traditional laboratory diagnosis for SDB is the AHI, which is measured by an overnight sleep study. Many surgeons have deluded themselves into thinking they can separate snorers from those with OSA (i.e., adult males with an AHI above or below 15). They then perform snoring surgery without a sleep test. Nothing could be further from appropriate. In my experience, 96% of men referred for snoring have an AHI of 5 or more, and 92% of women have an AHI of 5 or more.[4] In the same cohort, 81% of men had an AHI of 15 or more, and 64% of women had an AHI of 15 or more. From a quality care perspective, treating snoring without a sleep test cannot be condoned.



OXYGEN SATURATION INFORMATION

Saturation	100-95%	94-90%	89-85%	84-80%	79-70%	<70%
# Drops	0	179	24	2	0	0
# Minutes	339.6	126.4	3.8	0.1	0.0	0.0

Lowest O2 Sat was 83% at 21:55; a "Drop" is >= 4% O2 fall.

EVENT SUMMARY

Event type	Total# Events	Avg. Duration	Max. Duration	#Events/Hr.
Obstructive Apneas	32	29 sec	49 sec	4.1
Unclassified Apneas	0	0 sec	0 sec	0.0
Hypopneas *	159	21 sec	106 sec	20.3
Total # A+H *	191			**24.4**

* A hypopnea is defined as a 50% or more reduction in airflow for at least 10 seconds, accompanied by a decrease in blood oxygen saturation of at least 4%.

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Fig. 5. Sleep report with apnea-hypopnea index of 24.4. Waist is 102 cm. Neck circumference is 17 inches. This patient has severe snoring, moderate apneic episodes, and moderate excessive daytime sleepiness. Reproduced with permission of Michael Thomas, President, Sleep Solutions, Inc.

From a legal perspective, it cannot be defended. All patients suspect for SDB must have an overnight sleep test that measures respiration and calculates an AHI.

Actigraphy is the simplest and least expensive sleep test. Although widely used in Scandinavia, it has never been popular in the United States.[17] Actigraphy measures body movement at night. Those with SDB are more active. AHI is determined with a formula.

Oximetry has been used by some to screen for SDB.[18] Saturation of peripheral oxygen (SpO_2) is typically measured by transmitting a red infrared light through the finger or ear lobe, calculating a percent of hemoglobin molecules bound by oxygen molecules. Oximetry may be useful for documenting severe SDB, but, not for mild SDB, it is insensitive. For children, it has even less value because a child's apnea or hypopnea event is 8 seconds, and children generally do not desaturate in this time period. Most surgeons' knowledge of oximetry comes from the operating room and intensive care units. These oximeters cost $10,000 and are quite excellent. The oximeter used for most sleep testing costs $100. The numbers look good, but do not always translate to accurate, reliable findings. A negative sleep study SpO_2 does not rule out SDB. False-positives are uncommon. False-negatives are very common, especially at lower AHIs. The sleep test shown in Figure 5 demonstrates apneas and hypopneas without oxygen desaturation.

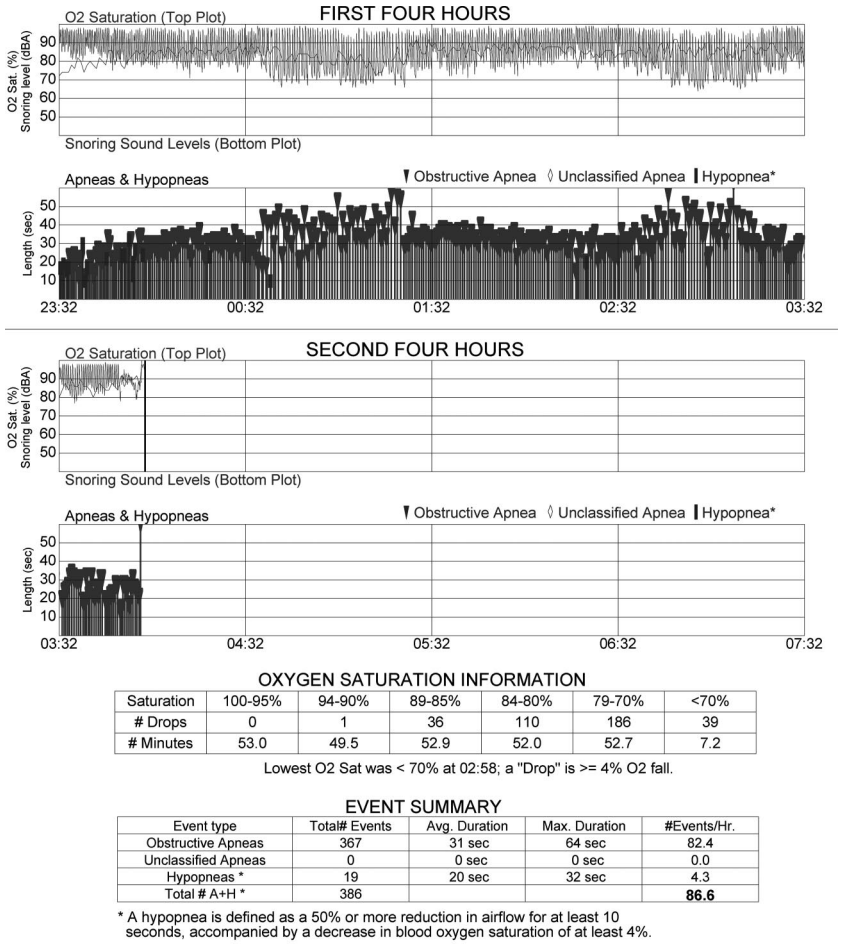
There are several multichannel home sleep test machines. An excellent sleep test machine is the WatchPAT 100 made by Itamar Medical of Israel. The WatchPAT 100 measures peripheral arterial tone. Apneas and hypopneas, presumably via sympathetic nervous system activity, create changes in peripheral arterial tone that is sensed by the WatchPAT. The WatchPAT also measures SpO_2 and body positions such as prone, supine, and lateral. The WatchPAT has been validated against PSG in numerous clinical trials.[19–22] Although the disposables are expensive, the WatchPAT is incredibly easy to use. It autoscores the data. It could not be easier to use or more accurate.

The next group of sleep multichannel home sleep tests measure airflow and oximetry. The airflow is typically measured through nasal prongs much like those used for providing nasal oxygen. The sensor measures pressure drop and calculates flow through the Rohrer equation: $\Delta p = k_1V + k_2V^2$, where k_1 is the laminar flow, k_2 is the turbulent flow, and V is the flow rate in L/s.[23] Our experience with the Embletta machine is that normal sized children ages 4 to 5 years have sufficient lung volumes to reliably complete a multichannel home sleep test. This is presumably a function of tidal volume. Tidal volume is variable, and so most use total lung capacity, a number that in healthy children best correlates with height. The latest recommendations for pulmonary function tests come from Wang et al.[24] for children and Hankinson et al.[25] for adolescents and adults. Regardless, in our 10 year experience with children, 4 year olds who are 100 cm (40 inches) in height successfully complete home sleep testing without having to change the sensitivity or algorithms of the home sleep test.

The nasal prongs provide good recordings even in those with moderate nasal obstruction. Some respiratory flow sensors use a thermistor positioned over the mouth. These are important for those with 100% nasal obstruction and are probably important for those with any significant nighttime

TABLE IV.
Home Sleep Diagnostic Devices, Manufacturers, and Websites.

Device	Manufacturer	URL
ApneaLink	ResMed	http://www.resmed.com
Apnea Risk Evaluation System	Advanced Brain Monitoring	http://www.b-alert.com
Apnoescreen	Viasys Healthcare	http://www.viasyshealthcare.com
Compas	Embla	http://www.embla.com
Edentec	SleepMed	http://www.sleepmed.md
Embletta	Embla	http://www.embla.com
LifeShirt	VivoMetrics	http://www.lifeshirt.com
MESAM IV	MAP	http://www.map-med.com
Monet	Embla	http://www.embla.com
Novasom QSG	Sleep Solutions	http://www.sleep-solutions.com
Poly-MESAM	MAP	http://www.map-med.com
Remmers Sleep Recorder (formerly SnoreSat)	SagaTech	http://www.sagatech.ca
Sandman	Puritan Bennett	http://www.sandmansleep.com
SNAP	Snap Laboratories	http://www.snaplab.com
Somnocheck	Weinmann	http://www.weinmann.de
Somnotrac Pro	Viasys Healthcare	http://www.viasyshealthcare.com
Somtç	Compumedics	http://www.compumedics.com
Stardust II	Respironics	http://www.respironics.com
WatchPat 100	Itamar Medical	http://www.itamar-medical.com



OXYGEN SATURATION INFORMATION

Saturation	100-95%	94-90%	89-85%	84-80%	79-70%	<70%
# Drops	0	1	36	110	186	39
# Minutes	53.0	49.5	52.9	52.0	52.7	7.2

Lowest O2 Sat was < 70% at 02:58; a "Drop" is >= 4% O2 fall.

EVENT SUMMARY

Event type	Total# Events	Avg. Duration	Max. Duration	#Events/Hr.
Obstructive Apneas	367	31 sec	64 sec	82.4
Unclassified Apneas	0	0 sec	0 sec	0.0
Hypopneas *	19	20 sec	32 sec	4.3
Total # A+H *	386			**86.6**

* A hypopnea is defined as a 50% or more reduction in airflow for at least 10 seconds, accompanied by a decrease in blood oxygen saturation of at least 4%.

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Fig. 6. Sleep report with apnea-hypopnea index of 86.6. Waist is 34 inches. Neck is 16 inches. This patient has no apneic episodes and no excessive daytime sleepiness. There are many oxygen desaturations. This study shows why history alone is not adequate and sleep test is required for evaluations. Reproduced with permission of Michael Thomas, President, Sleep Solutions, Inc.

nasal obstruction. A list of available multichannel sleep machines is given in Table IV. The Embletta made by Embla (Broomfield, CO) is the sleep machine the author uses for adults and children. The Embletta can be manually or autoscored. This group of sleep test machines require someone in the office dedicated to dispensing, scoring, and printing the sleep results. Once one develops a little experience, it achieves a successful recording on 95% of the nights used.

There are now two validated sleep testing units that use two channels, respiration and oximetry. Both are coded as 95806. Both are promoted and sold as screeners, but I believe they are simple, easy to use, highly accurate sleep tests. Although reimbursement for 95806 may not be great, these two units certainly distinguish the snorers from those with OSA. If the history and physical examination suggest snoring absent the morbidities of SDB, and there is a properly validated two-channel sleep screener report with an AHI less than 15, the patient can decline positive airway pressure (PAP) therapy and proceed directly to surgical snoring procedures.

Snoring is measured by nasal pressure, in which higher flow rates and greater force on vibrating structures produce lower frequency pressure changes, or by a microphone placed on the neck. These objective measures rarely correlate with sleep partner reports. I suspect all means of measuring snoring are flawed, including nasal pressure, cervical microphone, and bed partner report. For now, we tend to rely on the bed partner's report. Someday, science will need to find a validated, objective measure.

The next set of sensors to be discussed measure thoracic and abdominal movement. These are plastic bands with piezoelectric sensors. Normal respiration is seen as thoracic cage/chest expansion with abdominal shrinking as the diaphragms are pulled superiorly into the expanded thorax. Central sleep apnea is measured by complete absence of movement of either belt. Obstructive apneas are measured by paradoxical movement of the chest combined with abdominal expansion as the diaphragm contracts into the abdominal cavity.

The belts distinguish obstructive from central apnea. There is, however, a problem. Standard OSA patients do not generally have central sleep apnea. They often show central apneas on their sleep tests, but, once the patient is on PAP therapy, the central apneas often disappear. Some individuals at the outset of an airway obstruction cease respiratory effort. Perhaps this protects the lungs against negative pressure pulmonary edema. The event appears similar to a central apnea. The Current Procedural Terminology code 95806, the code used for multichannel home

sleep testing, requires four or more channels. The belts are the third and fourth channel.

All of the above-mentioned home sleep tests have autoscore capability. Autoscore is generally accurate. Figures 5 and 6 show examples of moderate and severe sleep reports in adults. Recordings can be manually checked and scored with many of the machines. This is of greatest value for sleep testing in children. Although 10 seconds is the standard adult apneic or hypopneic event, children are scored with 8 second intervals. Occasionally, a patient whom you suspect has SDB will autoscore with a low AHI. Reducing the time interval may change the result and produce an AHI more in line with your clinical prediction. You can also adjust the amplitude for apnea and hypopnea. Further details regarding home sleep testing are published elsewhere.[26,27]

The 16 channel PSG is traditionally performed in a laboratory and is attended by a trained sleep technician. The original test used was an electroencephalogram. A group at the University of Chicago had noted the rapid eye movements of dream sleep.[28] Periorbital electrodes were added and then respiratory channels, and the PSG became the tool to diagnose SDB. The 16 channels currently used for PSG are listed in Table V. They add little or no information to the AHI and, although certainly sophisticated and useful for illnesses other than SDB, they are complex and expensive. If this statement seems over broad, depending on one's definition of SDB, it is certainly valid for garden variety OSA.

PSG is currently the sleep test used in children. Home sleep testing is easily performed on children down to the age of 4 years and a height of 100 cm. Before 4 years, the child's lung volumes are insufficient to produce accurate recordings.

This is important for the head and neck sleep surgeon. Snoring affects 10% of children.[29] OSA affects 3%.[30] OSA is associated with neurocognitive problems, primarily behavioral problems.[31] Tonsillectomy and adenoidectomy improves neurocognitive function/behavior 90% of the time. However, the 7% with snoring but no SDB derive little benefit other than the cessation of snoring. It would make sense to test snoring children and only recommend surgery for those with documented OSA.

What is the abnormal AHI in prepubescent children? Five is clearly abnormal. Some have suggested 1 or 3. Even if an AHI of 1 were used as a cutoff, a sleep test would save many the risks and discomfort of tonsil surgery.

We have used the Embletta machine with children for many years. The results measured against outcome, not PSG, have been excellent. For the surgeon performing sleep testing, Embletta provides an added benefit and an added service.

Remember, when scoring pediatric sleep tracings, to reduce the length of the apnea and the hypopnea to 8 seconds. A nasal cannula specific to children is important to use because an adult cannula may not pick up a pediatric flow signal and may be uncomfortable. Adult autoscore is accurate for home sleep studies, but, in children, it is important to manually score these studies for artifacts. As previously mentioned for adults, oximetry measurements in children may not be accurate because of the quality of oximeters often used in home sleep testing. In addition, children rarely desaturate, so, unless the testing is being performed on a child with severe disease, it will rarely be abnormal, and, if in fact the child has severe disease, oxygen will hardly be necessary to make an accurate diagnosis.

TABLE V.
Physiologic Measurements Commonly Recorded During Polysomnography. These Typically Employ 16–50 Channels.

Electroencephalogram (EEG)
Odd's are left side
Even's are right side
A – central scalp
O – occipital
T – temporal
F – frontal
M – mastoid (reference)
Common leads
C3 – A2
C4 – A1
01 – A2
02 – A1
T3 – M2
T4 – M1
F3 – F4
Extraocular movements (EOM)
E – outer canthus
Common leads
E1 – M2
E2 – M1
Airflow
Snore
Flow-thermistor
Flow-pressure
Thoracic excursion
Abdominal excursion
Electrocardiogram (EKG)
Oximetry
Pulse
Sa O2
Electromyogram
Right anterior tibia (RAT)
Left anterior tibia (LAT)
Chin

An alternate diagnostic technique is to give those suspected of SDB an autotitrating positive airway pressure (APAP) machine or a continuous positive airway pressure (CPAP) machine with appropriately calculated pressure. If patients wear the PAP machine, by definition they have SDB and are being treated. No one without SDB would use a PAP therapy machine. Four studies and one editorial suggest that this is a valid paradigm with similar success rates to those sleep tested and placed on APAP or CPAP.[32–36]

There is heated discussion about the validity of home sleep testing. Home sleep tests and PSG use the same

TABLE VIA.
Studies Demonstrating Correlation between Multichannel Home Sleep Tests and Polysomnography.

Author	Year	Equipment	No. of Patients	Male	Female	Age	BMI	Syn	A Syn	AHI-PSG	AHI-Sleep Test	Correlation	Sensitivity	Specificity	Accuracy	Country
Redline	1991	Edentec	25	20	5	53	31	20	5	37	36	0.96	86%	95%	92%	USA
Man	1995	PolyG	104	81	23	47	30	104	0	16.9	14.6	0.97	86%	95%	92%	Canada
Bradley	1995	Autoset	31	26	5	46	30	31	0	25	28	0.85	100%	92%	92%	UK
Fleury	1996	Autoset	44	34	10	52	29	44	0	19	17	0.93	100%	87%	88%	France
Kiely	1996	Autoset	36	27	9	45	28	28	0	19	18	0.92	100%	92%	86%	Ireland
Whittle	1997	Edentec	23	19	4	50	30	0	23	27	25	0.8	NR	NR	82%	UK
Gugger	1997	Autoset	67	58	9	51	31	67	0	26	30	0.95	97%	77%	98%	Switzerland
Alymow	1999	Embletta	97	NR	NR	NR	NR	79	0	25	27	0.9	97%	93%	NR	Germany
Mayer	1998	Autoset	95	79	16	53	31	95	0	43	34	0.87	92%	79%	93%	France
Ballester	2000	Sibel Home	116	65	51	47	26	116	0	9.5	6.9	0.8	95%	92%	92%	Spain
Gomez-Jimenez	2000	Edentec	62	58	4	53	25–28	62	0	NR	NR	0.93	96%	NR	NR	Spain
Claman	2001	BedBugg	42	31	11	54	30.6	42	0	25.5	22.9	0.96	86%	95%	94%	USA
Reichart	2003	NovaSom	51	38	13	52	30	51	51	31.8	29.2	0.88	95/91	91/83	83%	USA
Bar	2003	WatchPAT	102	78	69	41	27	102	14	NR	NR	0.87	NR	NR	90%	Israel
Coyle	2003	LifeShirt	10	10	0	43	32.6	0	10	28	27	0.97	86%	100%	90%	USA
Dingli	2003	Embletta	101	80	21	48	32	40	61	14.2	13.8	0.98/0.74	NR	NR	NR	UK
Pittman	2004	WatchPAT	29	21	8	43	34	29	29	32	34	0.8	91%	86%	95%	USA
Su	2004	SNAP	60	25	35	45	36	60	0	27	26	0.92	98%	40%	95%	USA
Wang	2003	ApneaLink	50	36	14	55	30	50	0	NR	NR	0.98	100%	88%	90%	Germany
Ayas	2003	WatchPAT	30	19	11	47	31	30	0	23	23	0.87	91%	84%	87%	USA
Zou	2006	WatchPAT	98	55	43	60	28	98	0	25	27	0.9	90%	93%	82%	Sweden

BMI = body mass index; Syn = ; A Syn = ; AHI = apnea/hypopnea index; PSG = polysomnography.

TABLE VIB.
Weighted and Unweighted Averages for Home Sleep Tests versus Polysomnography.

	n	Unweighted Average	Weighted Average
No. of patients	21	60	60
Male	20	43	49
Female	19	18	25
Age	20	49	50
BMI	20	30	27
Syn	19	60	72
A Syn	7	27	27
AHI-PSG	18	25	24
AHI-sleep test	18	24	22
Correlation	21	0.9	0.9
Sensitivity	18	93%	94%
Specificity	17	81%	86%
Accuracy	18	90%	90%

BMI = body mass index; Syn = synchronous; A Syn = asynchronous; AHI = apnea/hypopnea index; PSG = polysomnography.

respiratory and oxygen monitors. They also use the same chest and abdominal movement sensors. They use the same actigraphs for body position. Therefore, for the purpose of measuring AHI and oxygen, there is no added benefit to the many additional measurements of the 16 lead PSG and neither is there obvious benefit to in-laboratory use versus at-home testing. Table VIA lists the currently available studies comparing home sleep testing and PSG, and Table VIB lists the weighted and unweighted averages across studies. There is no clear benefit of one test paradigm over the other. Given that the variation is 10% or less between the multichannel home sleep studies and a PSG and that night-to-night variability is 10%, the AHI will be the same whether measured by in-laboratory PSG or by multichannel home sleep test.

Treatment

PAP, be it CPAP or APAP, is the appropriate treatment for SDB. PAP is currently used connoting APAP or CPAP. Table VII shows the different anthropometric

TABLE VII.
Anthropometric Variables Favoring Upper Respiratory Tract (URT) Surgery versus Positive Airway Pressure (PAP) Therapy.

	URT Surgery	PAP therapy
Age	Less than 40	Over 40
BMI	Less than 30	Over 30
Mallampati	1 or 2	3 or 4
Tonsil	4	2 or 1
Waist male and female	Less than 102 cm (40 inches)	102 cm or more
EDS	Minimal	Moderate to severe
Nose	Polyps	
Tongue base	Wide open at endoscopy	Narrow at endoscopy

BMI = body mass index; EDS = excessive daytime sleepiness.

variables that indicate URT surgery or PAP therapy. Basically, anyone with an AHI of 15 or more, except those under 30 years of age and with four or more tonsils or obstructive nasal polyps and who probably should have these operated on independently of AHI, should be treated with PAP. "Lets give surgery a try" or "I don't want to use CPAP" are not surgical indications. The easiest way to dispense PAP is to develop a relationship with a local respiratory company who is a durable medical equipment (DME) provider and then refer all patients to them who have SDB. If the patient breathes through the nose at night, recommend a nasal mask. If he or she is a mouth breather, recommend a full face mask. The general prescription is use of APAP with a minimum pressure of 4 and a maximum pressure of 16 to 20. Ramp time is normally set at 20 minutes. Basically, when the PAP is turned on, it slowly ramps up to the treatment pressure. This is more comfortable as the patient falls asleep. Dispense PAP with the appropriate mask and heated humidification. Ask the DME to provide compliance data at 1 week, 1 month, and 3 months. If CPAP is required, there are formulae used to estimate the ideal pressure, but, generally, a PAP titration is recommended. As pressures change with time, weight gain, age, and the night's sleep, APAP is the author's preferred PAP therapy. The one major exception to this is the individual who is accustomed to CPAP and presents because they are snoring and suspect the pressure is too low. These individuals are most comfortable with CPAP and may not wish to change to APAP.

The DME should develop a program to nurture compliance. Compliance can be difficult for those who are claustrophobic. My own compliance program for those with difficulty is as follows: begin wearing an open mask at home without the hose while watching TV or reading for 5 days. Wear the open mask to bed for 3 days. Once comfortable with the mask, add the PAP machine while awake and watching TV or reading for several hours. Continue this until comfortable. Next, or finally, wear the PAP machine to bed. If the patient still cannot sleep, a sleeping pill such as eszopiclone (Lunesta, Sepracor, Marlborough, MA) or zolpidem tartrate (Ambien, Sanofi-Aventis, Bridgewater, NJ) will help and will not worsen SDB. If they still fail, forget it. Tell them to come in for a repeat evaluation when their symptoms worsen. A PAP machine does not need to be worn the entire night. As the patient becomes more comfortable, this will be less of a problem.

PAP failure as a surgical indication is for the person who begins to go to sleep with the machine but always wakens after an hour or two, typically with the mask off. These people, if they have anatomically correctable anatomy, can be considered for surgery.

There are difficult patients. These include those with respiratory diseases such as chronic obstructive pulmonary disease and emphysema. It also includes those with complex sleep apnea. Those with PAP machines requiring 14 or more cm of water may find the PAP uncomfortable. These people may benefit from an alternate ventilator device, such as bilevel positive airway pressure (BiPAP) which can be titrated in the lab or at home. Respironics provides a feature they call C flex. This is intended to provide full pressure with inspiration, but a stepdown pressure for expiration, much like conventional BiPAP. Individuals with complex breathing may require a complex breathing paradigm. PSG titration, BiPAP, and servo ventilation can be prescribed. This is outside the scope of most head and neck surgeons and is appropriately referred to those with sleep laboratories where titrations can be performed in the laboratory setting.

INSOMNIA

Insomnia is the most common sleep disorder and reportedly affects 40% of adults. The head and neck surgeon sleep medicine physician should know about insomnia for three reasons.

Daytime sleepiness is an important symptom of SDB. Because they are difficult to treat, insomniacs will frequently be referred to rule out SDB. Excessive daytime sleepiness (EDS), without snoring, URT obstruction, and UARS, does not warrant SDB evaluation. However, an SDB evaluation and sleep test may be necessary to satisfy the patient and the PCP that EDS is not SDB.

Second, there is an unfortunate group of people who suffer from both SDB and insomnia. They are a tough group to treat, both medically and surgically. To some degree, they represent the "difficult patient" in rhinoplasty: once one accepts responsibility for the presence if SDB, medical or surgical, one must also treat the insomnia or suffer the consequences of an unhappy patient and an unhappy referring physician. In addition, insomniacs are not always good surgical candidates because they are often hard to please.

Third, referring physicians should regard the head and neck sleep physician as a sleep specialist to whom they can refer all of their sleep medicine cases. If the surgeon only takes "surgical cases," but the medical sleep physician takes all patients and the PCP prefers a single contact/referral source for all sleep illness, then they will refer all patients to the medical sleep practice. It behooves the surgeon to be able to diagnose and treat insomniacs.

The PCP's approach to insomnia is often pharmacologic. Tragically, pharmaceuticals are not a successful therapy for chronic insomnia. There are books, papers, and philosophies covering this subject. Insomnia is a billion dollar industry. A list of currently useful sleep medications with doses and side effects are listed in Table VIII.

Insomnia typically takes two forms. The first is initiating sleep, the second is maintaining sleep. The insomniac's worst fear is a poor night's sleep. To avoid this, they go to bed early, hoping that if they are in bed for 9 to 10 hours, they will get a "decent" 7 or 8 hours sleep. When they suffer a poor night's sleep, they are tired the next day. It is interesting that, although insomniacs are frequently sleepy or tired (EDS is the language of SDB, not insomnia), they score normal on the Epworth Sleepiness Scale; specifically, they do not fall asleep at work, in front of the TV, or driving. However, they do not feel well, and they probably are not maximally productive.

The diagnosis of insomnia is clinical. The patients tell you their sleep difficulties. SDB patients have no difficulty initiating sleep or staying asleep. The insomniac generally obsesses over sleep or lack thereof. To begin, one must

TABLE VIII.
Common Sleep Medications used for Sleep.

Drug Name	Dose (mg)	Side Effects
Ambien (Zolpidem tartrate) (Sanofi-Aventis, Bridgewater, NJ)	5–10	Central nervous system: dizziness, headache, somnolence
Dalmane (Flurazepam) (Valeant, Costa Mesa, CA)	15–30	Cardiovascular: chest pain, flushing, hypotension, palpitation; central nervous system: apprehension, ataxia, confusion, depression, dizziness, drowsiness, euphoria, faintness, falling, hallucinations, hangover effect, headache, irritability, lightheadedness, memory impairment, nervousness, paradoxical reactions, restlessness, slurred speech, staggering, talkativeness; dermatologic: pruritus, rash; gastrointestinal: appetite increased/decreased, bitter taste, constipation, diarrhea, gastrointestinal pain, heartburn, nausea, salivation increased/excessive, upset stomach, vomiting, weight gain/loss, xerostomia; hematologic: granulocytopenia, leukopenia; hepatic: alkaline phosphatase increased, ALT/AST increased, cholestatic jaundice, total bilirubin increased; neuromuscular and skeletal: body/joint pain, dysarthria, reflex, slowing, weakness; ocular: blurred vision, burning eyes, difficulty focusing; respiratory: apnea, dyspnea; misc: diaphoresis, drug dependence
Doral (quazepam) (Medpointe, Somerset, NJ)	7.5–15	Cardiovascular: palpitation; central nervous system: abnormal thinking, agitation, anxiety, ataxia, confusion, depression, dizziness, drowsiness, euphoria, fatigue, headache, hyper-/hypokinesia, incoordination, memory impairment, nervousness, nightmare, paranoid reaction; dermatologic: dermatitis, pruritus, rash; endocrine and metabolic: libido decreased, menstrual irregularities; gastrointestinal: abdominal pain, abnormal taste perception, anorexia, appetite, increased/decreased, constipation, diarrhea, dyspepsia, nausea, xerostomia; genitourinary: impotence, incontinence; hematologic: blood dyscrasias; neuromuscular and skeletal: dysarthria, muscle cramps, reflex showing, rigidity, tremor; ocular: blurred vision; misc: drug dependence
Halcion (triazolam) (Par Pharmaceutical, Spring Valley, NY)	0.125–0.25	Central nervous system: drowsiness, anteriograde amnesia; central nervous system: somnolence; neuromuscular and skeletal: weakness; central nervous system: sedation; respiratory: respiratory depression
ProSom (estazolam) (Abbott, North Chicago, IL)	1–2	
Ativan (Lorazepam) (Mylan, Morgantown, WV)	2–4	
Sonata (zaleplon) (King, Bristol, TN)	5–10	Cardiovascular: chest pain, peripheral edema; central nervous system: amnesia, anxiety, coordination impaired, depersonalization, depression, dizziness, fever, hallucination, hypoesthesia, lightheadedness, malaise, migraine, somnolence, vertigo; dermatologic: photosensitivity reaction, pruritus, rash; gastrointestinal: abdominal pain, anorexia, colitis, constipation, dyspepsia, nausea, xerostomia; genitourinary: dysmenorrhea; neuromuscular and skeletal: arthralgia, back pain, myalgia, paresthesia, tremor, weakness; ocular: abnormal vision, eye pain; otic hyperacusis; misc: parosmia
Restoril (temazepam) (Mallinckrodt, St Louis, MO)	15–30	Central nervous system: confusion, dizziness, drowsiness, fatigue, anxiety, headache, lethargy, hangover, euphoria, vertigo; dermatologic: rash; endocrine and metabolic: decreased libido; gastrointestinal: diarrhea; neuromuscular and skeletal: dysarthria, weakness; ocular: blurred vision; misc: diaphoresis
Lunesta (Eszopiclone) (Sepracor, Marlborough, MA)	1–3	Central nervous system: headache; gastrointestinal: unpleasant taste; central nervous system: dizziness, headaches, sedation; gastrointestinal: nausea, xerostomia; ocular: blurred vision
Desyrel (Trazodone) (Watson, Morristown, NJ)	25–50	
Benadryl (Diphenhydramine) (McNeil, Fort Washington, PA)	50	Cardiovascular: hypotension, palpitation, tachycardia; central nervous system: sedation, sleepiness, dizziness, disturbed coordination, headache, fatigue, nervousness, paradoxical excitement, insomnia, euphoria, confusion; dermatologic: photosensitivity, rash, angioedema, urticaria; gastrointestinal: nausea, vomiting, diarrhea, abdominal pain, xerostomia, appetite increase, weight gain, dry mucous membranes, anorexia; genitourinary: urinary retention, urinary frequency, difficult urination; hematologic: hemolytic anemia, thrombocytopenia, agranulocytosis; neuromuscular and skeletal: tremor, paresthesia; ocular: blurred vision; respiratory: thickening of bronchial secretions
Unisom (Doxylamine) (McNeil, Fort Washington, PA)	25	Cardiovascular: palpitation, tachycardia; central nervous system: dizziness, disorientation, drowsiness, headache, paradoxical central nervous system stimulation, vertigo; gastrointestinal: anorexia, dry mucous membranes, diarrhea, constipation, epigastric pain, xerostomia; genitourinary: dysuria, urinary, retention; ocular: blurred vision, diplopia
Rozerem (Ramelteon) (Takeda, Deerfield, IL)	8	Central nervous system: headache, somnolence, dizziness, fatigue, insomnia worsened, depressed; endocrine and metabolic: serum cortisol decreased; gastrointestinal: nausea, diarrhea, taste perversion; neuromuscular and skeletal: myalgia, arthralgia; respiratory: upper respiratory infection; misc: influenza
Melatonin	0.5–6	Sedation or drowsiness
Valerian (herbal)	200–400	Drowsiness or sedation
Kava Kava (herbal)	250–500	Possible toxicity to the liver

exclude medical conditions such as renal failure and SDB. Many medications impair sleep, caffeine and nicotine being the most common. Alcohol also impairs sleep, as do many chemical addictions. Computer addicts also suffer insomnia. Insomnia is a chronic illness, very much like alcohol or chemical addiction. As such, it takes 2 years to resolve. There is not a pill, a trick, or anything else to hasten recovery.

Step 1 in the treatment of insomnia is sleep hygiene. Set a wake-up time for the rest of the person's life. This is when they must get up.

Step 2 is to develop a physical exercise program. Physical exercise is a potent sleep stimulant.

Step 3 requires the absence of caffeine in the late afternoon or evening. This includes coffee, tea, cola, chocolate, or other caffeine-containing foods. Naps should also be discouraged.

Step 4 requires the development of a personal relaxation program. Many insomniacs go to bed carrying the day's stress. Some literally work right up to bedtime. They must learn to "turn it off" several hours before bed time, and they must reduce activity to help them relax. Meditation is great. Computer games are not. TV is good for some. Reading a book is soporific for others. A hot bath or shower is relaxing for many. They should do whatever relaxes the mind and promotes sleep. It should be made a routine.

Step 5 requires the absence of alcohol. Alcohol may help relax and initiate sleep, but it impairs sleep, and with 15% of adult Americans addicted to alcohol, it is wise for patients to learn to sleep without ethanol.

There are various successful treatments. Cognitive behavioral therapy is great but requires money and an interested therapist. Sleep restriction is another successful treatment. Simply summarized, sleep is restricted so that the patient is so tired they sleep immediately and deeply. Sleep time is then slowly expanded, and the brain is slowly retrained to sleep through the night. Some begin with 5 hours sleep, some with 6. Some increase sleep 30 minutes twice a week, some more slowly.

I have not been successful recommending sleep restriction. Scandinavians report success. A modification that has worked for my patients is to restrict sleep to 7 hours with the caveat that if the patient cannot sleep, he or she gets out of bed and does something and then tries again to sleep in 30 minutes. Regardless of how long patients sleep, they must get up at their designated time.

If, on awakening, they know they will be tired, they are provided a prescription for modafinil (Provigil). This application is off label. Fifty to 100 mg is the typical dose. This should keep patients reasonably awake during the day, but because they are now sleep deprived, they should sleep that night. One is not supposed to adapt to or become addicted to modafinil, but I think patients do. Therefore, they are encouraged to use the modafinil sparingly. Because most insurance companies will not pay for modafinil, patients may have to pay for the prescription. This helps restrict use. In addition, one can prescribe zolpidem tartrate (Ambien) or eszopiclone (Lunesta) or other sleeping pills for those nights when patients need to have a full night's sleep. If they can restrict this to one to two uses per week, the program will work. If they medicate more frequently, it will not. Follow-up is recommended at 1 month and then only as required. The motivated patient will succeed. The unmotivated patient will fail.

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