Not Every Patient Needs to Go to the Sleep Lab

An Update and Controversy

November 19, 2004
Controversy: The issue is not whether some patients should have treatment without testing, but how many and which ones?
A Confession: I’ve Done It Already. Examples:

- Morbidly obese patients admitted to the ICU with respiratory failure
- Indigent, non-insured patients who can afford to buy a re-tooled CPAP machine ($200-400) but who cannot afford a sleep study ($800-1600)
- Wealthy patients who “know” they have sleep apnea, want CPAP, and are willing to pay out of pocket for it
Some Assumptions

- Polysomnography and diagnostic criteria for sleep apnea are imperfect.
- Clinical skills (eg, history and physical examination) can establish a likelihood of sleep apnea with some certainty in some patients.
- Auto-titrating CPAP is as effective as in-lab titrated CPAP.
- Cost of a sleep study (PSG) is $800-$2000.
- Cost to purchase auto-titrating CPAP machine is $500-800 (high end).
- Sleep apnea is common, and getting more so
- “Inappropriate” CPAP is harmless.
- Untreated sleep apnea kills.
The “Gold Standard” is Imperfect

- False negative sleep studies
  - No REM sleep
  - No Supine sleep
  - No alcohol, muscle relaxants, etc
-Insensitive monitoring devices
  - Thermocouples instead of pressure monitors
- Lack of standard diagnostic criteria
  - Is a hypopnea a 3% or 4% desat? + arousal?
  - Is sleep apnea an RDI of 5, 10, 15?
Factors to Consider

- **AHI**
  - Does not account for duration of respiratory events, degree of O2 desaturations, or amount of sleep disturbance

- **Oxygen desaturation**
  - Correlates best with outcomes, but not well-studied
  - Most reliable and reproducible

- **Sleep disturbance**
  - Does not predict much except sleepiness
What IS Sleep Apnea, Anyway?

  - AHI’s of 1-10 are associated with increased cardiovascular risk
- Guilleminault et al, *Chest*, 1993
  - Subtle respiratory events (“RERA’s”) cause somnolence which is reversible with CPAP
  - Snoring is associated with many of the risks associated with sleep apnea
UARS (Upper Airway Resistance Syndrome) Guilleminault et al, 1993

- Study Population: Patients with idiopathic Hypersomnia. 15 had UARS
- Diagnostic Criteria: $\geq 5$ RERA’s/hr (Respiratory Effort Related Arousals, eg, abnormal increases in respiratory effort preceding arousals, with very low Pes prior to arousals.)
- Treatment: nCPAP eliminated the sleepiness (MSLT scores rose) and arousals
What About “Simple Snoring?”

- Snoring in pregnancy is associated with increased hypertension and growth retardation, controlling for weight, age, smoking. (Franklin, Chest, 2000)
- Snoring is associated with cognitive decline (Quesnot, J Am Geriatric Soc, 1999)
- Snoring medical students are more likely to fail exams, controlling for BMI, age, sex. (Ficker, Sleep, 1999).
- Snoring is a risk factor for cardiovascular disease in women. (Hu, J Am Coll Cardiol 2000).
Disease is a Spectrum...

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**Men**

1: BMI 25-32
2: BMI 32-36
3: BMI 36-40
4: BMI 40-75

**Women**

1: BMI 25-32
2: BMI 32-36
3: BMI 36-40
4: BMI 40-75

**Mortality Risk vs. Systolic Blood Pressure (mmHg)**
Sleep-Disordered Breathing is a Spectrum

- Obesity-Hypoventilation (Pickwickian Syndrome)
- Severe OSA
- Moderate OSA
- Mild OSA
- UARS
- Chronic, Heavy Snoring
- Intermitent Snoring
- Quiet Breathing
“Arguments over the definition of obstructive sleep apnoea/ hypopnoea syndrome (OSAHS) have still not been satisfactorily resolved. As a result, robust estimates of the prevalence of OSAHS are not possible. New approaches are needed to identify those who have "CPAP responsive" disease, enabling more accurate estimates to be made of the prevalence of the sleep apnoea syndrome in the community.”

Stradling and Davies

Thorax, 2004
So, how good are standard clinical tools in diagnosing sleep apnea (whatever that is?)

- N=300
- BMI, neck circumference, oral cavity measurements
- Model predicted AHI > 5
  - Sensitivity 97.6%
  - Specificity 100%
  - PPV 100%

- N = 100
- Multicenter trial
- Berlin questionnaire: queries about snoring, sleepiness, obesity, hypertension
- Being identified as “high risk” predicted an RDI > 5
  - Sensitivity: 86%
  - Specificity: 77%
  - PPV: 89%
Exam: Tonsillar Hypertrophy

OK, so which patients and how many could go straight to treatment without testing?
The Use of Clinical Prediction Formulas in the Evaluation of Obstructive Sleep Apnea
Rowley et al, *Sleep* 2000

  - age, BMI, witnessed apneas, hypertension
- Maislin et al, *Sleep* 1995
  - sex, BMI, age, snorting, snoring, witnessed apneas
  - Neck circumference, hypertension, habitual snoring, choking
  - Sex, age, snoring, BMI
Rowley’s Analysis

- A prospective application of 4 clinical prediction models to 370 subjects
  - 46.5 (38-56) years
  - BMI 37.1 (30.7-46.6) Kg/m2
  - 52% male
  - 52% hypertensive
  - 67% had AHI > 10; 49% had AHI > 20
- Hypopnea required 3% desaturation
- “OSA” was defined as AHI ≥ 10 events/hr
- Sensitivity, specificity, positive and negative predictive values were calculated
“... these tests would significantly increase the yield of detecting patients with an AHI > 20...if we utilized Model 4 (Maislin)...39% of the patients with an AHI \geq 20 would be identified with only 7% of the patients with positive results being falsely identified.”

Rowley’s Conclusion
About 40% of patients could go straight to auto-titrating CPAP without polysomnography. 7% may be falsely identified (or may have UARS, or milder OSA). Careful follow up would be necessary. Much time and money would be saved.

My conclusion
## Comparison of Patients with and Without Sleep Apnea

<table>
<thead>
<tr>
<th></th>
<th>OSA present</th>
<th>OSA Absent</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td>47</td>
<td>46</td>
<td>NS</td>
</tr>
<tr>
<td><strong>BMI (kg/m²)</strong></td>
<td>39.2</td>
<td>33.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>NC (cm/in)</strong></td>
<td>43/16.93</td>
<td>40/15.75</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>M:F</strong></td>
<td>145:103</td>
<td>46:76</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td><strong>% HBP</strong></td>
<td>53</td>
<td>48</td>
<td>NS</td>
</tr>
<tr>
<td><strong>% snoring</strong></td>
<td>81</td>
<td>70</td>
<td>0.014</td>
</tr>
<tr>
<td><strong>% witnessed apnea</strong></td>
<td>69</td>
<td>48</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td><strong>% gasping</strong></td>
<td>49</td>
<td>38</td>
<td>&lt;0.037</td>
</tr>
</tbody>
</table>
OK, so how would you treat a patient with suspected sleep apnea without establishing a CPAP pressure by in-lab titration?
Autotitrating CPAP

- Most commonly, increases pressure to eliminate vibration of palate and soft tissue
- Costs $200-300 more than “straight” CPAP
- May improve compliance
- Results in lower pressure overall
Comparison of Autotitrating vs In-Lab Titrated CPAP

Hudgel et al, 2000, n=33

- Pressures were lower on APAP
  - CPAP: 8-16, mean 10.6
  - APAP: 3-13, mean 6.4
- ESS improved the same amount
  - (initial: 15, follow-up: 8 on CPAP, 9 on APAP)
- Compliance was the same
  - Total use: CPAP 427 hrs, APAP, 492 hrs
  - ≥ 4 hrs/night: CPAP 66%, APAP, 73.5%
OK, but how many people does this affect?
## Comparison of the Prevalence Rates of Obstructive Sleep Apnea to Cancer, Heart Disease and Stroke in the United States

<table>
<thead>
<tr>
<th>Condition</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence of Obstructive Sleep Apnea*</td>
<td>2-4%</td>
</tr>
<tr>
<td>Prevalence of Patients who ever had Cancer*</td>
<td>~3%</td>
</tr>
<tr>
<td>Prevalence of Coronary Heart Disease**</td>
<td>~5%</td>
</tr>
<tr>
<td>Prevalence of Stroke**</td>
<td>~1%</td>
</tr>
</tbody>
</table>


* Data estimated from Cancer Facts and Figures, 1995 and 1990 US Census

** Data estimated from *Heart & Stroke Facts*, 1995 and US Census
Figure 1. Smoothed plot (5-year moving average) of the prevalence of an apnea-hypopnea index (AHI) of 15 or greater by age.
Why Sleep Apnea Isn’t Going Away.....

There’s a Little McDonald’s In Everyone

www.somethingawful.com
Over Treatment Vs Under Treatment of Sleep Apnea

“Unindicated” CPAP
- $1000 cost
- Rhinorrhea, stuffiness, nose abrasions, etc

Untreated Sleep Apnea
- Cardiovascular disease
- Car wrecks
- Hypertension
- Neuropsychiatric deficits
- Death
- Impotence
Positive Airway Pressure: Problems
But what is the risk to the patient if he does have sleep apnea, and hassle and cost prevent or delay him from getting CPAP?
Consequences of Obstructive Sleep Apnea

- Impaired cognitive function
- Impaired quality of life
- Daytime sleepiness
- Increased risk of automobile accidents
- Increased health care costs
- Hypertension
- Cardiovascular disease
- Worsened glucose tolerance
- Increased mortality rates
- Impotence
Why Sleep Apnea is a public health problem.
Consequences: Automobile Accidents

Accident/driver/5 yrs

Findley et al. Amer Rev Respir Dis 1988
The Epworth Sleepiness Scale

How likely are you to doze off or fall asleep in the following situations, in contrast to just feeling tired? This refers to your usual way of life in recent times. Even if you have not done some of these things recently, try to work out how they would have affected you. Use the following scale to chose the *most appropriate* number for each situation:

- 0 = would *never* doze
- 1 = *slight* chance of dozing
- 2 = *moderate* chance of dozing
- 3 = *high* chance of dozing

<table>
<thead>
<tr>
<th>Situation</th>
<th>Chance of Dozing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting and reading</td>
<td></td>
</tr>
<tr>
<td>Watching TV</td>
<td></td>
</tr>
<tr>
<td>Sitting, inactive, in a public place</td>
<td></td>
</tr>
<tr>
<td>As a passenger in a car for an hour</td>
<td></td>
</tr>
<tr>
<td>Lying down in the afternoon</td>
<td></td>
</tr>
<tr>
<td>Sitting and talking to someone</td>
<td></td>
</tr>
<tr>
<td>Sitting quietly after a lunch without alcohol</td>
<td></td>
</tr>
<tr>
<td>In a car, while stopped for a few minutes in traffic</td>
<td></td>
</tr>
</tbody>
</table>
The following sleepiness scale can be helpful in determining how much sleeping disorder you have. How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired? This refers to your usual way of life in recent times. Use the following scale to choose the most appropriate number for each situation.

0 = would never doze
1 = slight chance of dozing
2 = moderate chance of dozing
3 = high chance of dozing
4 = Always

SITUATION

Sitting and reading

Watching Television

Sitting, inactive in a public place (theater or movie)

As a passenger in a car for an hour without a break

Lying down to rest in the afternoon

Sitting and talking to someone

Sitting quietly after a lunch without alcohol

In a car, while stopped for a few minutes in traffic

driving down Interstate

For each of the beverages listed, write in the average number that you drink each day.
What is the evidence that CPAP reduces the risk?
CPAP: Benefits

- Improved cognitive function
- Improved quality of life
- Reduced daytime sleepiness
- Reduced risk of automobile accidents
- Reduced health care costs
- Reduced blood pressure
- Reduced cardiac arrhythmias
- Reduced mortality rate
- Reversal of impotency
Figure 2. Changes in blood pressure with effective (closed bars) and subtherapeutic (open bars) nCPAP. *Significant difference. MAP indicates mean arterial blood pressure; systolic, systolic blood pressure; and diastolic, diastolic blood pressure. MAP, $P=0.01$; systolic blood pressure, $P=0.04$; diastolic blood pressure, $P<0.005$. 
Benefits of CPAP: Mortality

(Al>20, ALL AGES)

Cumulative Survival

Interval Years

He et al. Chest. 1988;94
Conclusions

- Polysomnography and CPAP titrations are imperfect and over-rated tools.
- Sleep-disordered breathing is a spectrum, not an all-or-nothing phenomenon.
- We have over-emphasized the AHI in particular, and technology in general.
- It is illogical to spend more time and money diagnosing something than treating it, especially if the treatment is safe, cheap and effective and the disease can kill.
- We must still be clinicians and use clinical judgment.
Not Every Patient Needs To Go to the Sleep Lab
November 19, 2004
Barbara Phillips, MD, MSPH

Clinical Prediction Formulae


Complications


Complications, continued


Diagnosis/definitions


Portable Monitoring


40. Pittman SD, Ayas NT, MacDonald MM, Malhotra A, Fogel RB, White DP. Using a wrist-worn device based on peripheral arterial tonometry to diagnose obstructive sleep apnea: In-laboratory and ambulatory validation. Sleep 2004; 27: 923-33.
Snoring


UARS/RERAs


CPAP Treatment-General

55. ww.hcfa.gov (go to http://www.hcfa.gov/coverage/8b3%2D8bb1.htm)

CPAP Treatment-Benefits


**CPAP Treatment-Benefits, continued**


