Snoring & Sleep Apnea

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  – NIH K23 HL068849 (Weaver)
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Objectives

1. Answer 10 common questions
2. Educate you on snoring and sleep apnea
3. Show a little of our research that impacts clinical practice
Question 1

Why do I snore?
Mouth & Throat (inside)
Why do I snore?

- Tissues vibrate in sleep
- Muscles relaxed in sleep

(44% men & 28% women habitually snore.)
Snoring Risk Factors

• Anatomy
  – Big uvula, floppy palate, tonsils

• Position
  – On your back

• Breathing pattern
  – Mouth breathing (nose blocked)

• Sedation
  – Sleep deprivation, alcohol, meds
Question 2

I see the ads for snoring treatment. Do they work?
BREATHE EASY AND STOP SNORING!

Finally, a "stop snoring" product that works! The Breathe Fit Snoring Aid promotes easier breathing by applying gentle pressure to the septum to open nasal passages. Forget adhesives and clumsy gadgets. Breathe Fit is reusable, washable and easy to insert. Try it for yourself ... and for someone you love.

1070A Original Breathe Fit Snoring Aid $29.95
TRAIN YOURSELF TO STOP SNORING!

Silent Night Snore Stopper looks like a wristwatch and is an easy and safe solution for your snoring. Wear it on your wrist when going to sleep and the tiny microphone detects snoring and sends safe electronic pulses to the wrist, working like a gentle nudge from your spouse. The pulses are not powerful enough to disrupt your sleep, but will make you change position and then the snoring stops. Two intensity levels. 2” diameter. Extended use may actually train the body to stop snoring.

1570A Snore Stopper $39.95
Snoring Treatment

• Fix snoring factors:
  – Sleep position
  – Clear nasal congestion
  – Avoid sedatives (eg, alcohol)

• Palate stiffening
  – Clinic procedure
  – 60% success (not bothersome)
  – Snoring can recur
Palate Stiffening: For Snoring

Radiofrequency

Injection

Implants
Non-palatal Snoring
Non-palatal Snoring
Question 3

My spouse/partner chokes during sleep. What is going on?
Sleep Apnea!

(DEMO)
Lying on the back
Palate Obstruction
Tongue Obstruction
Sleep Testing
Definition
Obstructive Sleep Apnea

- Recurrent upper airway obstructions during sleep
- Apnea-hypopnea index $\geq 5$
Sleep Testing Definitions

- Apnea = 10 second cessation of airflow
- Hypopnea = 10 second decrease in airflow
- AHI = apnea + hypopnea / hour of sleep
- AHI $\geq 5$ is mild sleep apnea
- AHI $> 15$ is moderate
- AHI $> 30$ is severe

(10-17% men & 3-9% women have moderate or severe apnea)
Question 4

It looks bad. Is it bad?
Severe Sleep Apnea
Severe Sleep Apnea

POOR SLEEP = DAILY EFFECTS
Symptoms

• Snoring, disturbed sleep
• Morning headache, throat discomfort
• Daytime sleepiness, fatigue
  – Kids: Attention Deficit Hyperactivity Disorder
• Mood swings, irritability, depression
Symptoms

- Snoring, disturbed sleep
- Morning headache, throat discomfort
- Daytime sleepiness, fatigue
  - Kids: Attention Deficit Hyperactivity Disorder
- Mood swings, irritability, depression
## Accidents

<table>
<thead>
<tr>
<th>Accident Type</th>
<th>Relative Risk: Apnea v Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-car</td>
<td>9.6</td>
</tr>
</tbody>
</table>

Corrected for driving exposure. All $p<0.001$

Severe Sleep Apnea

POOR SLEEP = DAILY EFFECTS

OXIDATIVE STRESS = MEDICAL EFFECTS
Medical Effects

- Cardiovascular disease
- Stroke
- Diabetes
- Cancer (incidence and metastases)
- Death
Death

N = 1396
Untreated

Sleep 2008; 31:1071-8
Is it bad?

Yes, if symptomatic or if severe.
I heard it is due to being overweight. I'm not, but I have apnea. Why?
Sleep Apnea Risk Factors
(same as snoring)

• Anatomy
  – Body weight affects airway anatomy
  – Many other anatomical factors
• Position
• Breathing pattern
• Sedation
• Weak muscle tone
Big Tongue

Normal

Big Tongue
Normal Oral Exam
Behind the Palate

Normal

Narrow
Behind the Palate
Position

Upright

On Back
Floppy Tissue

Normal

Floppy Epiglottis
Question 6

What can be done about it?
Conservative Therapies

• Sleep hygiene
  – Adequate sleep, consistency, no sedatives
• Sleep position
• Throat exercises
• Very little data
Didgeridoo
Weight Loss

• Obesity: major apnea risk factor
• Weight loss improves apnea
  – 10% excess body weight loss → 30% reduction in apnea
  – Full weight loss rarely cures apnea
• Sustained weight loss difficult
Medication

• None treats sleep apnea
Positive Airway Pressure

- CPAP, BiPAP, AutoPAP
- “The machine”
- “The mask”
- Pneumatic splint
CPAP
CPAP
CPAP

• Controls symptoms
• Improves quality of life
• Reduces accidents
• Reduces risk of medical problems
• Improves survival
Relationship Between Hours of CPAP Use and Achieving Normal Levels of Sleepiness and Daily Functioning

Terri E. Weaver, PhD, RN, FAAN; Greg Maislin, MS, MA; David F. Dinges, PhD; Thomas Bloxham, MD; Charles F. P. George, MD; Harley Greenberg, MD; Gihan Kader, MD; Mark Mahowald, MD; Joel Younger, MD; Allan I. Pack, MD, PhD

Figure 1

![Graph showing the relationship between hours of nightly CPAP use and achieving normal levels of sleepiness and daily functioning. The graph plots the percentage of patients with normal values against different hours of CPAP use categories: <=-2, >2,<4, >=4,<5, >=5,<6, >=6,<7, and >=7. The categories are represented by different markers: FOSQ, ESS, and MSLT.]
Mortality of Veterans with Sleep Apnea: Untreated versus Treated

Weaver EM,1,4,5,2 Maynard C,3,2,6 Yueh B1,2,4,6

Logrank test, p<0.001

CPAP (N=28,612)
Untreated (N=116,678)

Weaver, Sleep 2004;27:A208
CPAP Difficulty

- Acceptance and tolerance
  - Cumbersome
  - Side effects
- Adequate use
Question 7

What are the alternatives to “the mask?”
Jaw Advancement Splint
Jaw Advancement Splint
Jaw Advancement Splint

- Controls symptoms
- Improves quality of life
- Reduces accidents
- Reduces risk of medical problems
- Improves survival
- Less effective but better tolerated than CPAP
Sleep Surgery

• Procedures to open or stabilize the upper airway
• Broad array of procedures, often
  – Some combined, some staged
  – Combination with CPAP or jaw splint
• NOT just isolated procedures
Sample of Nasal Airway Surgeries

- Septoplasty
- Turbinate fracture
- Turbinate intramural cautery
- Turbinate submucous resection
- Turbinate excision
- Turbinate radiofrequency reduction
- Concha bullosa reduction
- Nasal valve suspension
- Nasal valve stabilization
- Spreader grafts
- Park flaring suture susp
- Batten grafts
- Columellar strut graft
- Columellar reduction
- Other functional rhinoplasty procedures
- Polypectomy
Sample of Upper Pharyngeal Surgeries

- UPPP
- Uvulopalatal flap
- Extended UPF
- Lateral palatopharyngoplasty
- Expansion sphincter pharyngoplasty
- Lateral palatopexy
- Palatal advancement pharyngoplasty
- Adenoidectomy
- Tonsillectomy
- Palate stiffening
Uvulopalatal Flap
Tonsillectomy
Tonsillectomy
Sample of Lower Pharyngeal Surgeries

- Genioglossus advancement
- Hyoid suspension
- Midline glossectomy
- Lingualplasty
- Lower lateral pharyngoplasty
- Lingual tonsillectomy
- RF tongue reduction
- Tongue suspension
- CN12 stimulation
- Epiglottoplasty
- Mandibular sliding osteotomy
Lingual Tonsillectomy
Lingual Tonsillectomy
Midline Glossectomy
Pre-op: Upright, breathing at rest
Post-op: Upright, breathing at rest
Genioglossus Advancement
Genioglossus Advancement
Global Airway Surgeries

- Maxillo-Mandibular advancement
- Tracheotomy
- Bariatric surgery
Maxillo-Mandibular Adv
Maxillo-Mandibular Adv
Question 8

I heard surgery does not work. Does it work?
Does it work?

• Depends on what you mean by “it”

• Depends on what you mean by “work”
“It”

- Procedures to open or stabilize the upper airway
- Broad array of procedures, often
  - Combined, staged
- NOT just isolated procedures
“Work” = Cure

- Surgery usually does not eliminate and CURE sleep apnea

- But neither do CPAP or jaw splint
“Work” =

• Controls symptoms
• Improves quality of life
• Reduces accidents
• Reduces risk of medical problems
• Improves survival
• YES, surgery works!
Surgery

• Less effective than CPAP (when used full time)

• But surgery effect occurs all the time
Studying Life Effects & Effectiveness of Palatopharyngoplasty (SLEEP) Study: Subjective Outcomes of Isolated Uvulopalatopharyngoplasty

Edward M. Weaver, MD, MPH, B. Tucker Woodson, MD, Bevan Yueh, MD, MPH, Timothy Smith, MD, MPH, Michael G. Stewart, MD, MPH, Maureen Hannley, PhD, Kristine Schulz, MPH, Milesh M. Patel, MS, David Witsell, MD, MHS, and the SLEEP Study Investigators

Objective. To test the hypothesis that uvulopalatopharyngoplasty (UPPP) improves sleep apnea-related quality of life (measured on the Functional Outcomes of Sleep Questionnaire [FOSQ]) at 3-month follow-up. Secondary objectives were to test (1) the stability of the outcomes at 6 months, (2) the effect on global sleep apnea quality-of-life change, and (3) the effect on sleep apnea symptoms.

Study Design. Multicenter, prospective, longitudinal case series.

Setting. Diverse university- and community-based otolaryngology practices.

Subjects and Methods. The cohort included 68 patients from 17 practices, with a mean ± standard deviation age of 44 ± 12 years and mean apnea-hypopnea index of 35 ± 32 events/hour. All patients underwent UPPP, defined as an open procedure modifying the shape and size of the palate, pharynx, and uvula, with or without tonsillectomy. Baseline data were collected on site before surgery, and outcome data were collected by mail 3 and 6 months after surgery, with follow-up rates of 51% and 50%, respectively.

Results. FOSQ scores improved from 14.3 ± 3.4 (scale 5-20, normal ≥17.9) at baseline to 17.2 ± 2.7 at 3 months (mean improvement 2.9; 95% confidence interval, 1.8-4.0; P < .001) and 17.5 ± 2.5 at 6 months (mean improvement 3.1; 95% confidence interval, 2.0-4.2; P < .001). All quality-of-life and symptom measures improved significantly at 3 and 6 months (all P < .05).

Conclusion. This prospective, multicenter; university- and community-based study provides evidence that UPPP significantly improves disease-specific quality of life and sleep apnea symptoms in patients with sleep apnea. Validity may be limited.
# Surgery Symptoms

## Table 2. Outcomes Between Baseline, 3 Months, and 6 Months

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Baseline, Mean ± SD</th>
<th>3 Months, Mean ± SD</th>
<th>6 Months, Mean ± SD</th>
<th>P-Value² (0-3 mo)</th>
<th>P-Value² (0-6 mo)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Functional Outcomes of Sleep Questionnaire (5-20)</td>
<td>14.3 ± 3.4</td>
<td>17.2 ± 2.7</td>
<td>17.5 ± 2.5</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Secondary</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epworth Sleepiness Scale (0-24)</td>
<td>12.9 ± 5.5</td>
<td>7.0 ± 4.7</td>
<td>6.9 ± 4.2</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Sleep apnea symptoms (0-5)</td>
<td>3.7 ± 1.1</td>
<td>1.1 ± 1.5</td>
<td>1.5 ± 1.7</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Awakening with headache, d/wk</td>
<td>1.7 ± 2.3</td>
<td>1.0 ± 2.1</td>
<td>1.0 ± 1.9</td>
<td>.048</td>
<td>.008</td>
</tr>
<tr>
<td>Sleep apnea problem VAS (0-100)</td>
<td>68 ± 30</td>
<td>24 ± 28</td>
<td>24 ± 27</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Snoring VAS (0-100)</td>
<td>53 ± 32</td>
<td>8 ± 12</td>
<td>18 ± 22</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Global sleep apnea QOL change, −7 to +7b</td>
<td>—</td>
<td>3.5 ± 2.6</td>
<td>2.5 ± 2.7</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Weaver, OtoHNS 2011;144:623-31
Surgery Quality of Life

Weaver, OtoHNS 2011;144:623-31

*\( p < 0.001 \)
Mortality of Veterans with Sleep Apnea: Untreated versus Treated
Weaver EM,1,4,5,2 Maynard C,3,2,6 Yueh B1,2,4,6

Introduction: Untreated obstructive sleep apnea (OSA) appears to increase mortality. The effect of treatment on mortality rate is unclear because most previous reports analyzed small samples and did not adequately control for comorbidity. We sought to determine whether providing a continuous positive airway pressure (CPAP) device or performing uvulopalatopharyngoplasty (UPPP) is associated with a decreased mortality rate relative to providing no treatment for OSA, in a large cohort with control for comorbidity.

Methods: This retrospective inception cohort study included all patients diagnosed with OSA in any Veteran Affairs (VA) inpatient facility 1991 - 2001 or outpatient facility 1997 - 2001. Subjects were identified by ICD9 diagnostic codes in the VA inpatient and outpatient treatment files. Treatment status (None, CPAP, UPPP, or tracheotomy) was determined by ICD9 or CPT procedure codes in these databases. Patients without a code for CPAP, UPPP, or tracheotomy were considered untreated. Patients undergoing tracheotomy were not included in this analysis, because indications for tracheotomy could not be determined. CPAP patients were provided a CPAP device, but usage data were not available. Sleep apnea severity data were not available. The Charlson Comorbidity Index was calculated from ICD-9 diagnostic codes from the year prior to inception into the cohort. Mortality data were extracted from VA Death Files. Survival time was calculated from the date of first diagnosis of OSA to date of death or 9/30/2002. Treatment groups were compared on mortality hazard with Cox regression, adjusting for age, sex, race, comorbidity, and inception year.

Results: The cohort consisted of 149,267 veterans, age 57±/12 (mean+/SD) years, 97% male. By September 2002, 16,967 of 116,678 untreated patients (14.5%), 3256 of 28,612 CPAP patients (11.4%), and 394 of 3977 UPPP patients (9.9%) were dead (untreated v treated, p<0.001). From the date of OSA diagnosis, untreated patients survived 3.6+/2.3 years, CPAP patients survived 4.6+/2.5 years, and UPPP patients survived 5.3+/2.5 years (untreated v treated, p<0.001). After adjusting for the variables listed, untreated patients had 1.9 (95%CI 1.8-2.0, p<0.001) times greater hazard of dying at any time relative to treated patients. UPPP patients had a lesser mortality rate (p=0.006), longer survival (p<0.001), and lesser hazard of death (adjusted hazard ratio 0.57, 95%CI 0.39-0.81, p=0.002) relative to CPAP patients.

Conclusion: Treatment with CPAP or UPPP confers a survival advantage over no treatment, after adjustment for age, sex, race, comorbidity, and year of OSA diagnosis. One cannot draw conclusions about the relative efficacy of CPAP and UPPP because CPAP usage data were not available.
Surgery Survival

- UPPP = 3,977
- CPAP = 28,612
- No Tx = 116,678

Weaver, Sleep 2004;27:A208
Question 9

Is surgery too risky?
Surgery Risks

• Short-term recovery is difficult
  – PAIN!!
  – Difficulty eating
  – Taste change
  – Weight loss
  – Fatigue
  – Bleeding risk
Surgery Risks

- Long-term recovery well tolerated
  - Most side effects are minor and improve
  - Swallowing feels different
  - In three studies: 89% of patients had no regret with palate surgery

Incidence of Serious Complications After Uvulopalatopharyngoplasty

Eric J. Kezirian, MD, MPH; Edward M. Weaver, MD, MPH; Bevan Yueh, MD, MPH; Richard A. Deyo, MD, MPH; Shukri F. Khuri, MD; Jennifer Daley, MD; William Henderson, PhD

- N = 3130 veterans
- Severe sleep apnea
- 1.5% non-fatal serious risks
  - Infection, blood clot, blood transfusion, pneumonia, etc.
- 0.2% fatal (30 days)

Kezirian, Weaver, Laryngoscope 2004; 114:450-3
Short-term Risk vs. Long-term Benefit

• What is the short-term risk of peri-operative death?

• Does it require a significant short-term mortality risk to gain a long-term survival benefit?
Surgery Survival

- UPPP = 3,977
- CPAP = 28,612
- No Tx = 116,678

Kaplan-Meier survival estimates, by therapy

UPPP

CPAP

No Tx

Weaver, Sleep 2004;27:A208
Surgery Survival

Kaplan-Meier survival estimates, by therapy

- therapy = No Tx
- therapy = CPAP
- therapy = UPPP

Surgery Survival

Weaver, Sleep 2004;27:A208

1 month
Surgery Survival

• Surgery improved survival:
  – Long-term
  – Short-term
    • Above and beyond the small acute post-operative risk of death
Question 10

What about sleep apnea in kids?
Adults & Kids Similar

- Poor sleep
- Snoring
- Observed choking
- Many treatments
Adults & Kids Different

• Severity ratings
• Patterns of obstruction
• Kids can grow out of it
• Behavioral consequences in kids
• Kids most commonly from tonsils
• Surgery (tonsillectomy) is primary treatment in kids
10 Questions

2. Do snore aids work? Sometimes.
3. What is my partner’s choking? Sleep apnea!
4. Is it bad? Yes, unless mild and no symptoms.
6. What can be done about it? Life modifications, and usually CPAP.
8. Does surgery work? Not cure, but improves symptoms and health effects.