

**The Hip Bone is Connected to the Sleep Bone?  
and/or  
Sleep Medicine Pearls  
From a Busy Non-Academic Sleep Center**

Jason W.W. Thomason, MD, FCCP, D-ABSM

NCSRC Symposium  
Wilmington, N.C.  
September 30, 2011

[www.salemchest.com](http://www.salemchest.com)

**Disclosures**

- **Jason W.W. Thomason, M.D., FCCP, D-ABSM**
  - Pulmonary, Critical Care, and Sleep Medicine
  - Salem Chest Specialists, Winston-Salem, N.C.
  - Medical Director of the Southeastern Sleep Disorders Center of SCS
- No direct affiliation with Novant Health
- No direct affiliation with DME companies
- APNEX medical P.I. on current trial...more later

**Outline**

**Part 1**

- Background/definitions
- Sleep center day-to-day

**Part 2**

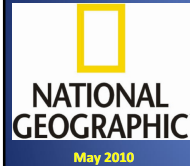
- Orthopedic Research
- presented at the SOA meeting - July, 2011

**Part 3**

- Interesting Cases
- Future therapy for OSA?

**The Secrets of Sleep**

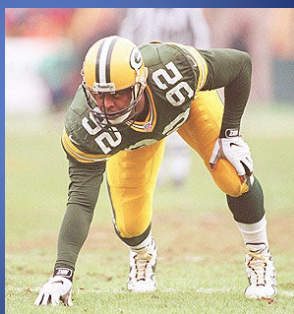
From birth, we spend a third of our lives asleep.  
After decades of research, we're still not sure why.



...resulting in "fatal cardiac arrhythmia," said Dr. Mike Sullivan, the medical examiner for Mecklenburg County....sleep apnea may have been a factor.

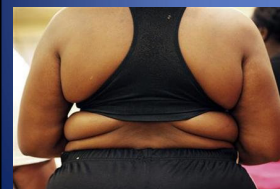


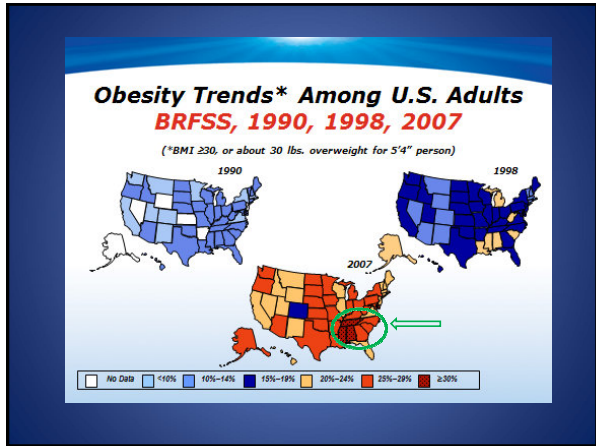
Reggie "Minister of Defense" White  
age 43 (1961 – 2004)



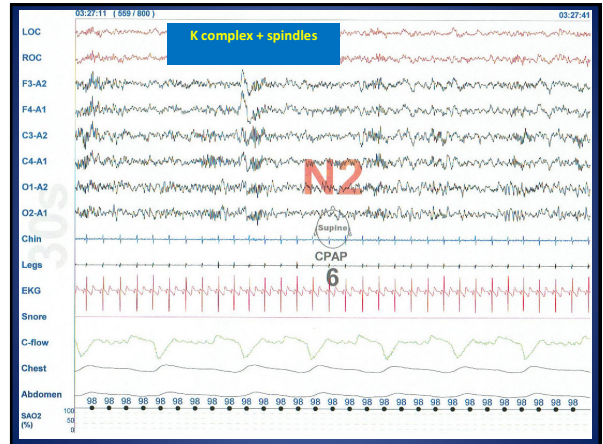
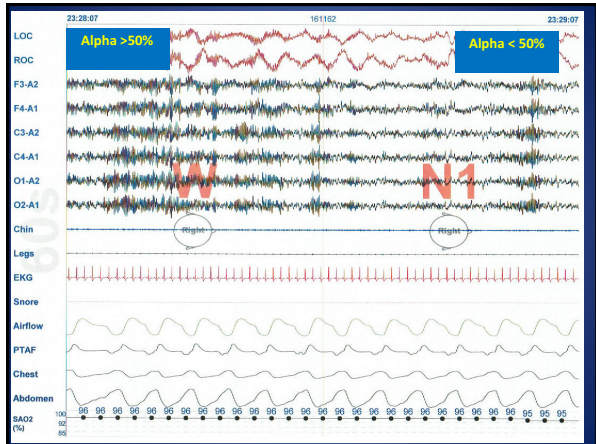
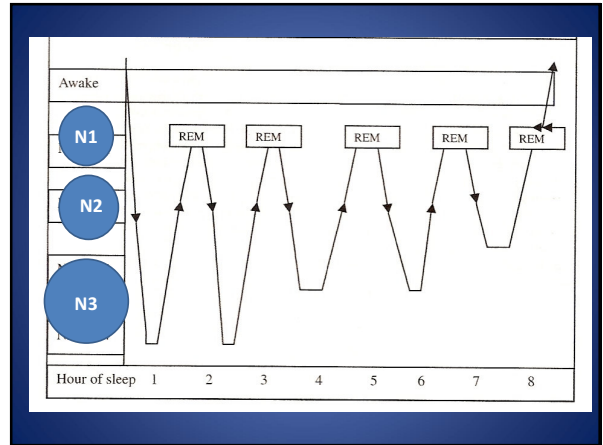
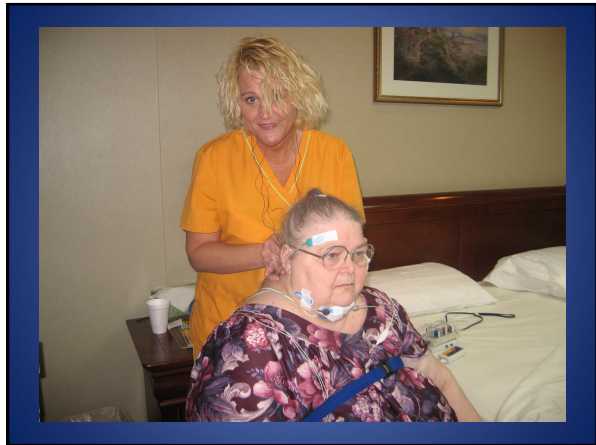
**July 7, 2011**

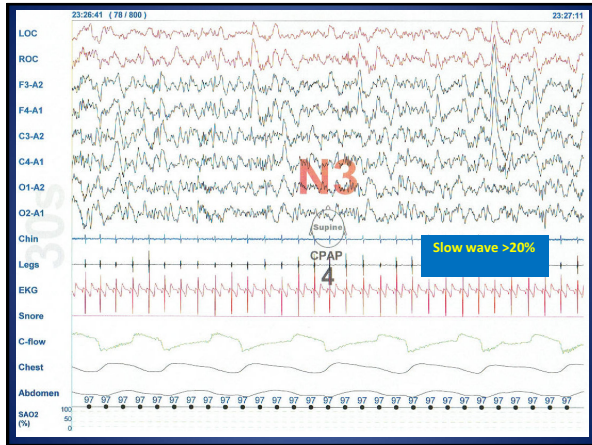
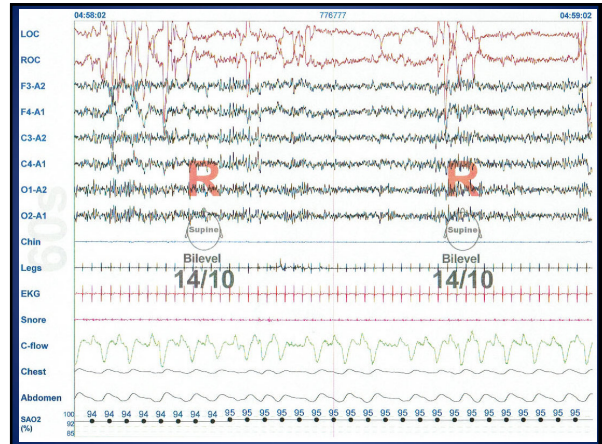
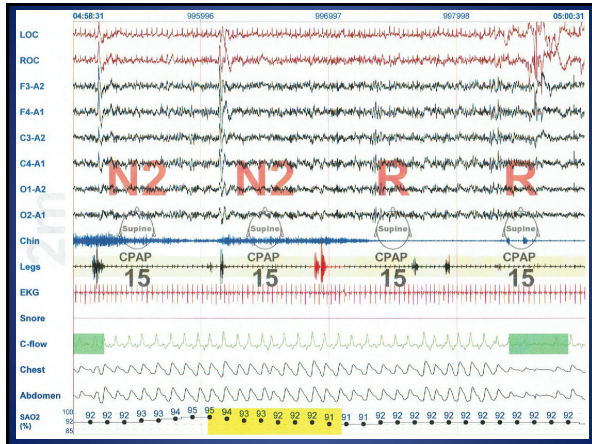
**LOS ANGELES (Reuters)** - The number of obese U.S. adults rose in 16 states in the last year, helping to push obesity rates (BMI > 30) above 30 % in 12 states!





## Sleep Staging





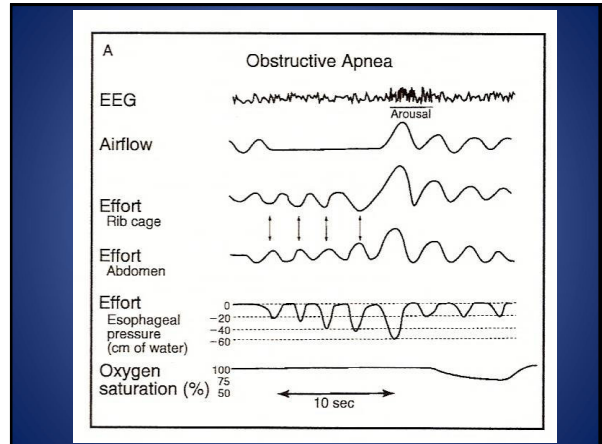
## Obstructive Sleep Apnea

- Complete cessation of airflow x10 seconds...or longer
- Continued respiratory effort
- Occurs > 5x per hour
- Usually a decrease in O<sub>2</sub> Saturation >4%

## Obstructive Sleep Hypopnea

- 30% reduction in airflow x10 seconds
- Continued respiratory effort
- Decrease in O<sub>2</sub> saturation >4% (or >3% if effort reduced by 50%)
- Combined with apneas = Apnea/Hypopnea Index (AHI)
  - <5 = "normal"
  - 5-15 = "mild"
  - 16-30 = "moderate"
  - >30 = "severe"

Does NOT take into account O<sub>2</sub> desaturation...



## TAKE HOME MESSAGE: OSA and Cardiovascular Risks

- General**
- 15 million Americans with OSA
  - Most do NOT know that they have this...
- HTN**
- 50% of OSA pts have HTN
  - 30% of HTN pts may have OSA
  - Pts with more severe OSA, difficult to control BP, and better CPAP compliance do the best
- Heart Failure**
- 11 – 37% of CHF pts have OSA
  - Less often c/o sleepiness
  - Men > women
  - > 50% if diastolic failure
- Stroke**
- Difficult to study without bias (survivors)
  - Higher incidence immediately afterwards
  - AHI > 20 may be higher risk
  - 10 yr f/u after stroke shows higher mortality in pts with OSA
- Arrhythmias**
- 50% of OSA pts display some type
  - Non-sustained V-Tach, sinus arrest, 2<sup>nd</sup> degree av-block, frequent PVC's (>2 per min)
  - 4x risk for atrial fibrillation
    - 82% of recurrence in 1 year after cardioversion if left untreated
    - Half that % if treated with CPAP
  - Increased risk for sudden cardiac death in the early morning hours (NEJM)
- Pulmonary HTN**
- AHI > 20 = 20%
  - Usually mild, rare to have PAP > 35mmHg
- End Stage Renal Disease**
- Small series, 40-60%

## Patient Screening / Procedures

## The Epworth Sleepiness Scale

How likely are you to fall asleep in these situations?

Activity	Score
Sitting and reading	0 - 3
Watching TV	0 - 3
Sitting inactive in a public place (e.g. in a theater or mtg)	0 - 3
Sitting quietly after lunch without alcohol	0 - 3
Sitting in a car as a passenger for 1 hour without a break	0 - 3
Lying down to rest in the afternoon when able	0 - 3
Talking to someone	0 - 3
In a car, while stopped for a few minutes in traffic	0 - 3
<b>Total</b>	<b>___ / 24</b>

None = 0  
Slight = 1  
Mod. = 2  
High = 3

## Modified Mallampati airway classification system

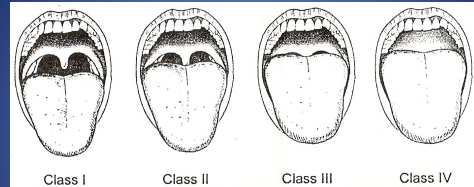


Figure 1—Mallampati Airway Classification (I-IV Scale). During assessment, the patient is instructed to open his or her mouth as wide as possible, while protruding the tongue as far as possible. Patients are instructed to not emit sounds during the assessment. Class I: soft palate and entire uvula visible; Class II: soft palate and portion of uvula visible; Class III: soft palate visible (may include base of uvula); Class IV: soft palate not visible

## “STOP-BANG” Questions

- S** – snoring  
**T** – tiredness  
**O** – observed apneas (ask sleeping partner)  
**P** – pressure (HTN)
- B** – body mass index ( $\geq 35 \text{ kg/m}^2$ )  
**A** – age (> 50 yrs)  
**N** – neck circum. ( $\geq 16''$  women;  $\geq 17''$  men)  
**G** – gender (male)

\*Sensitivities at AHI cutoffs greater than 5, 15, and 30 = 83.6, 92.9, 100%

## Sleep Disordered Breathing Questionnaire

- neck circumference = \_\_\_\_\_ inches
- >16" for women Y N  
>17" for men Y N
- Height = \_\_\_\_\_
- Weight = \_\_\_\_\_ BMI >30 Y N
- Do you snore? Y N
  - Do you choke or gasp for breath when you sleep? Y N
  - Has anyone told you that you stop breathing during your sleep? Y N
  - Do you feel tired or fatigued during the wake time hours? Y N
  - Has your weight increased in the past five years? Y N
  - Have you ever nodded off or fallen asleep while driving? Y N
  - Do you feel tired or groggy upon awakening, or do you awaken with a headache? Y N
  - Do you often have problems with memory or concentration? Y N

\*Yes to 3 or more = needs referral for possible sleep apnea

## Thomason Questionnaire

**Referral Form to Salem Chest Specialist**  
(Pulmonary and Sleep Medicine)  
ATTENTION: AMANDA FRYE or DEROLENE BENTLEY  
FAX: 760-331-  
phone: 765-0383

Patient Name: \_\_\_\_\_ Date of Birth: \_\_\_\_\_  
Referring Physician: \_\_\_\_\_ JCA # \_\_\_\_\_  
Date of planned surgery (if known): \_\_\_\_\_

Reason for Consult: Sleep Apnea  \_\_\_\_\_ // Other: \_\_\_\_\_

Patient Contact Information: \_\_\_\_\_  
Home \_\_\_\_\_  
Cell \_\_\_\_\_  
Work \_\_\_\_\_  
Family \_\_\_\_\_

Insurance Information  
If insurance card is available, please fax a copy of the card in lieu of below  
Name of Company: \_\_\_\_\_  
Certificate #: \_\_\_\_\_

Day/Time of ICU admission: \_\_\_\_\_  
ICU Physician: \_\_\_\_\_

## Sleep Clinic Referral Form

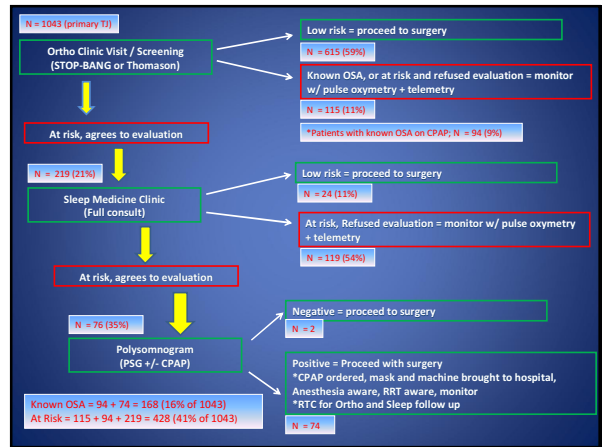
## Results

## Results - Study Group 2009, 2010, 2011

**1043 total patients studied**

- 618 primary TKA
- 363 primary THA
- 62 UKA

*\*no revision patients included*



### Demographics of Patients Studied (n=76)

• Age	61	• PSG (+)	97.4%
• Female	58%	• AHI (ave)	37 <i>(*severe &gt; 30)</i>
• BMI	38.9	• Oxygen nadir	81%
- Ht	66 in	• Split night	25%
- Wt	239lbs	• CPAP (ave)	11cmH2O
• Neck Circ	16.7	• Ave time b/w sleep clinic and PSG	8.82 days
• Epworth	8.5 / 24 <i>Normal ≤ 10</i>		

### Complications and Delays (n=76)

Complication Type		National Averages (OSA/Ortho)	
Aspiration	0	Aspiration	(1.18%)
ARDS	0	ARDS	(1.06%)
*PE	2 (2.6%)	*PE	(0.51%)
Intubation	0	Intubation	(3.99%)
Arrhythmia	1 (1.3%)		
Acute Hypoxia	3 (3.9%)		
Transfer to ICU	0		
Death	0		
# Surgical Delays	0		
<i>-Ave time from clinic to OR 5 wks</i>			

*\*Increased plt aggregation due to endothelial dysfunction (increased factor XIIIa, fibrinogen, thrombin-antithrombin complex, etc.) ??*

## Conclusions - 1

### Hypotheses:



- Higher prevalence of OSA among our large, community-based total joint replacement practice
  - Compared to national averages

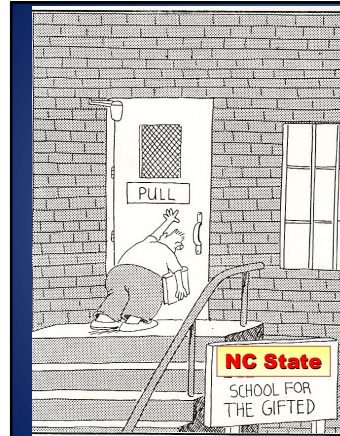


- Patients often go unrecognized, contributing to adverse outcomes
  - Outcomes can improve with a well organized screening and monitoring process



- Well organized screening can be done without delays in surgery

## Conclusions - 2



Sleep and oxygen are good for you.

## Part 3 Interesting Cases

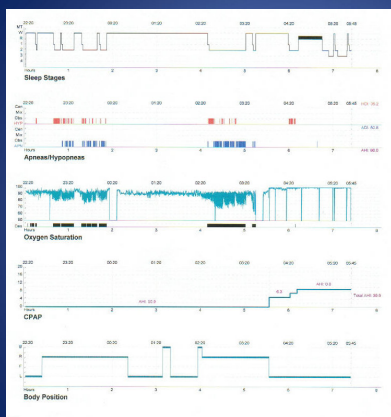
- Have I seen this patient in the clinic/hospital recently?
- Have I slept next to this patient?
- Am I this patient?

### Case 1 = "Howe Special" (pre-operative screening)

54 y/o f  
Pre-op orthopedics L knee replacement

Neck Circ = 18 in  
BMI = 64  
ESS = 13 / 24

Sxs: 4-drug HTN



AHI = 139  
59%  
CPAP 9 cmH2O

### Case 2 = CVA

55 y/o m

- Rehabilitation center referral
- s/p CVA with some weakness R arm

Sxs:

- 4-drug HTN
- Hyperlipidemia
- Former smoker

CC:

- Loud snoring, daytime sleepiness

Other:

- Father died at age 55 from a stroke

PE:

- Neck Circ = 17.5 in
- MIP = 4
- Wt = 199 // Ht = 73
- ESS = 16 / 24

**Conclusion of a large, observational cohort study examining the role of OSA in the development of first stroke or death from any cause.**

**OSA is associated with increased incidence which is independent of other cardiovascular and cerebrovascular risk factors, including HTN.**

Table 3. Trend Analysis for the Relationship between Increased Severity of the Obstructive Sleep Apnea Syndrome and the Composite Outcome of Stroke or Death from Any Cause (N=1022).<sup>a</sup>

Severity of Syndrome	Stroke or Death		Mean Follow-up Period, yr	Hazard Ratio (95% CI)
	No. of Events	No. of Patients		
AHI ≤3 (reference score)	13	271	3.08	1.00
AHI 4-12	21	258	3.06	1.75 (0.88-3.49)
AHI 13-36	20	243	3.09	1.74 (0.87-3.51)
AHI >36	34	250	2.78	3.30 (1.74-6.26)

<sup>a</sup> P<0.005 by the chi-square test for linear trend. AHI denotes apnea-hypopnea index, and CI confidence interval.

Obstructive sleep apnea as a risk factor for stroke and death. NEJM, November 10, 2005.

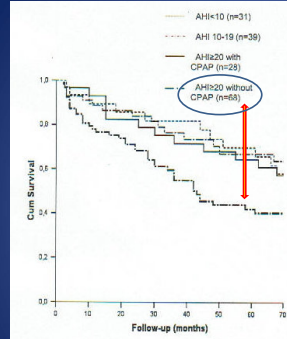


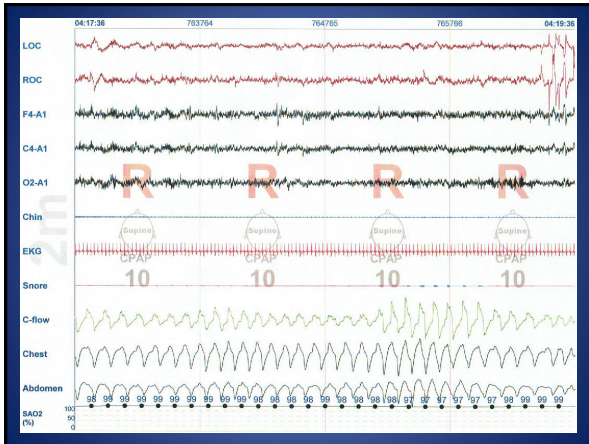
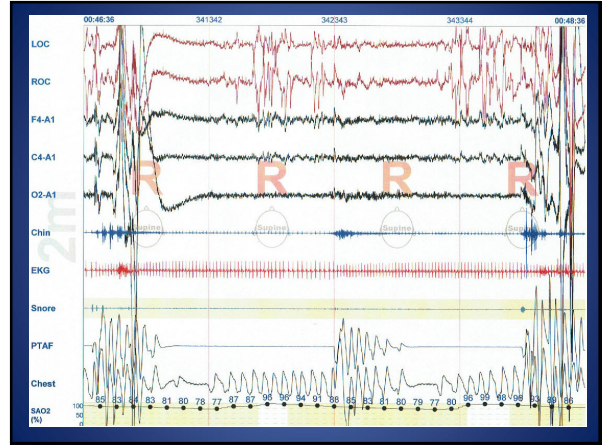
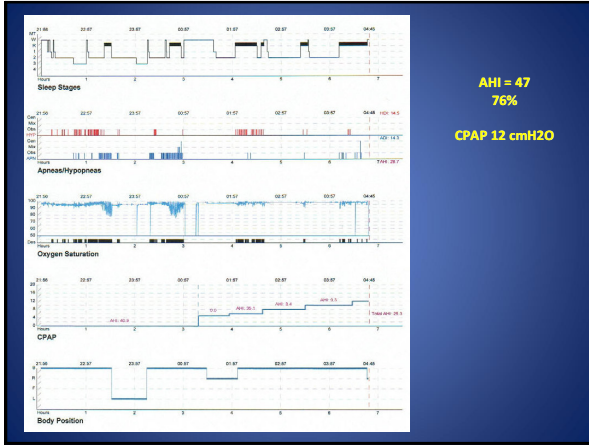
Figure 2. Accumulated survival curve for study groups of patients with stroke, by apnea-hypopnea index (AHI) cutoff point and continuous airway pressure (CPAP) tolerance. The group of patients with stroke with an AHI of 20 or greater and poor tolerance of CPAP showed more mortality than the rest of the patients after 5 years of follow-up. Cum = cumulative.

**Long term CPAP treatment in moderate to severe OSA and ischemic stroke is associated with a reduction in excess risk of mortality.**

**Independent of initial severity of neurological event, cv risk factors, age, and sex.**

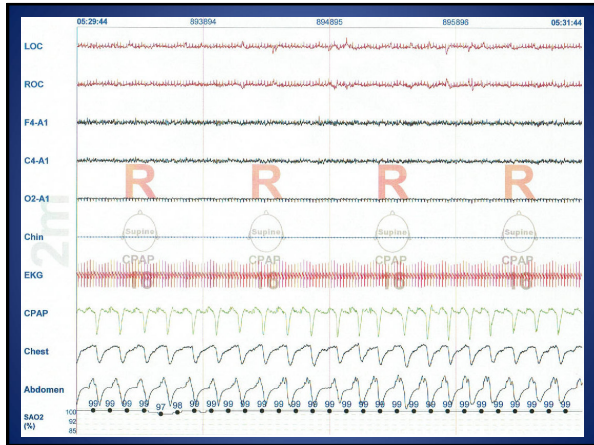
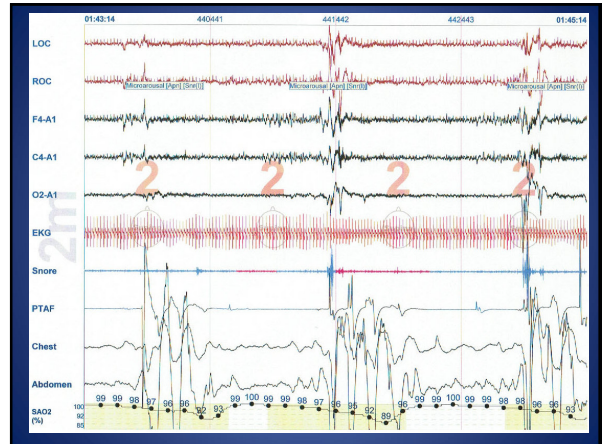
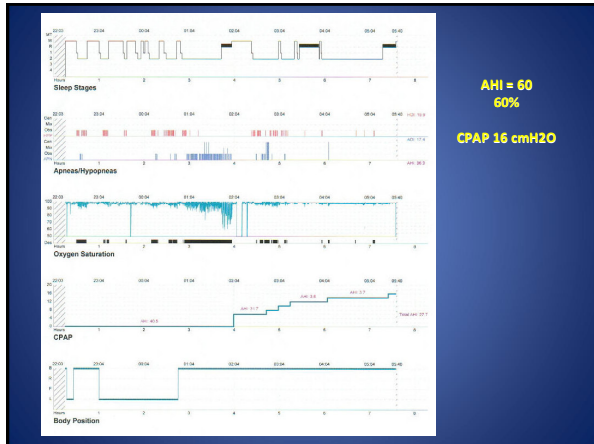
**AHI > vs < 20**

CPAP treatment reduces mortality in patients with ischemic stroke and OSA – a 5 year follow-up study. AmJRespirCritCareMed, April, 2009.



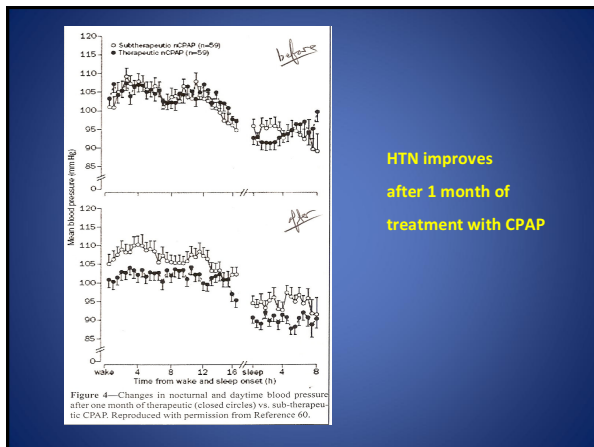
### Case 3 = CVA

- 57 y/o m
- Post-hospital referral
  - s/p CVA and right sided hemiparesis
  - had a (+) apnea link...6 months prior = patient did not want to "bother with it"
- Sxs:
- 4-drug HTN
  - Insulin dependent DM
- CC:
- Loud snoring, sleeping in a recliner
- PE:
- Neck Circ = 18.5 in
  - MP = 4
  - BMI = 42
  - ESS = 15 / 24



## OSA + Hypertension

- Hypertension 2003;42:1067-1074
- JAMA 2000;283:1829-1836
- Obstructive sleep apnea and its cardiovascular consequences.
  - Lancet. January 3, 2009.
- Obstructive sleep apnea and cardiovascular disease.
  - Circulation Journal. August, 2009.
- Sleep apnea and cardiovascular disease.
  - JACC. August, 2008.

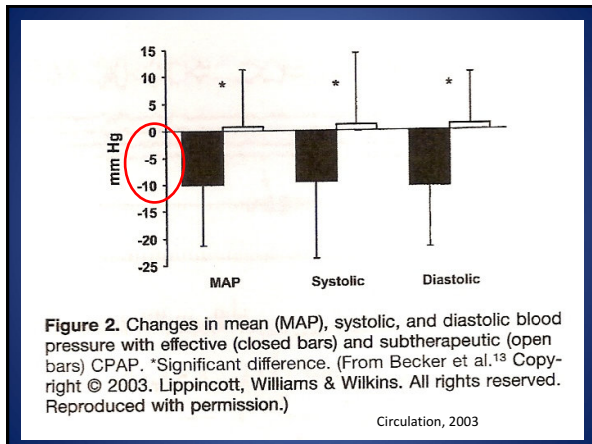


## Case 1 = "Howe Special"

(pre-operative screening)

4-drug HTN





### Case 4 = CAD, HTN

50 y/o m

- Cardiology referral

CC:

- "sleepy all day"

PE:

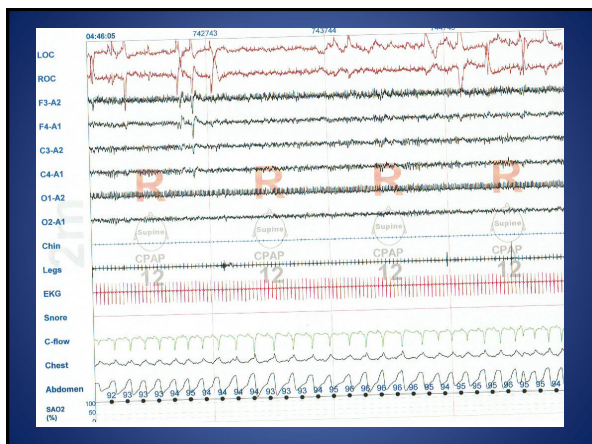
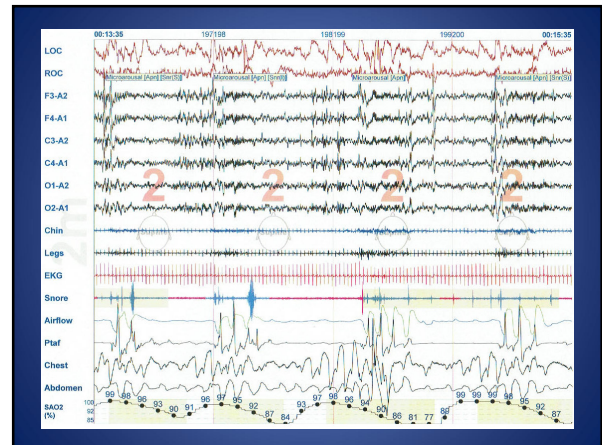
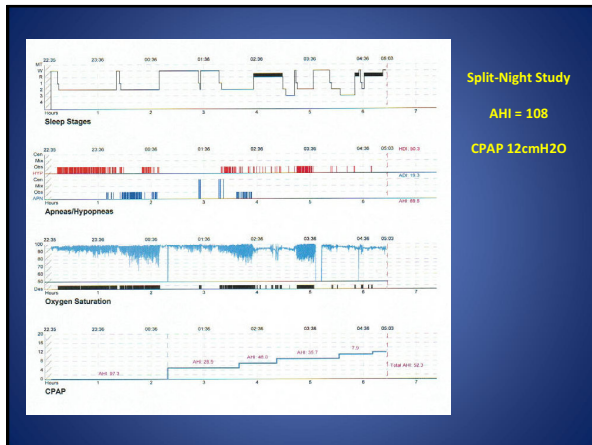
- Neck Circ = 18 in
- BMI = 34

Sxs:

- Loud snoring,
- naps every day
- "gasping for air" at night
- AM headaches

PMHx:

- HTN, CAD, DM, tobacco



### Case 5 = HTN, aortic valve

82 y/o m

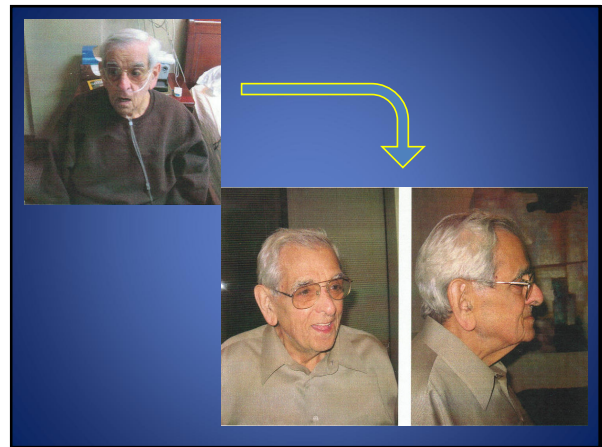
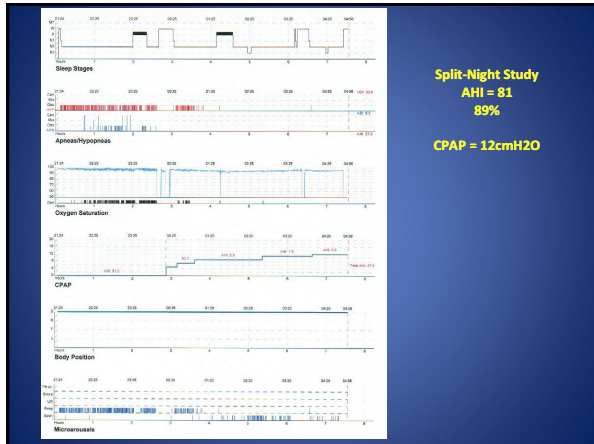
- Near-drowning, following golf cart accident and fresh water pond in 2009

PE:

- Neck Circ = 17 in
- Ht = 5'7" / Wt = 210 lbs
- ESS = 12 / 24

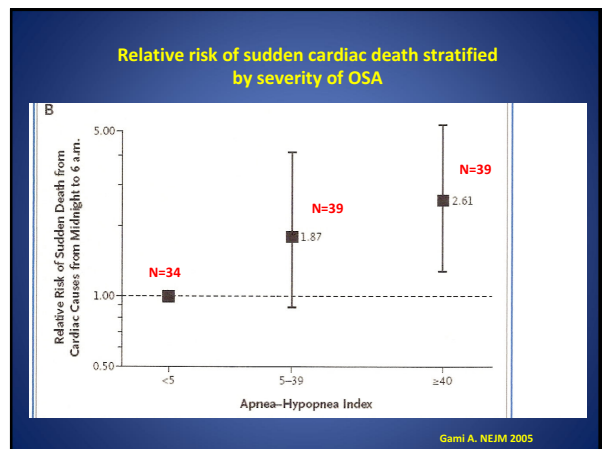
PMHx

- 3-drug HTN
- Pacemaker
- Aortic valve surgery, but still dyspneic, hypoxic at night, and ongoing edema



## OSA + Arrhythmias

- AJRCCM 2006(173):910-916
- SLEEP 2005;28(12)1543-1546
- NEJM 2005(352);12 March 2005
- Obstructive sleep apnea and its cardiovascular consequences. — Lancet. January 3, 2009.
- Obstructive sleep apnea and cardiovascular disease. — Circulation Journal. August, 2009.
- Sleep apnea and cardiovascular disease. — JACC. August, 2008.

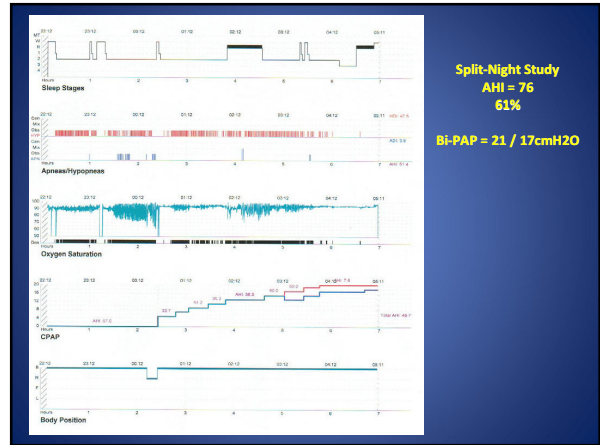
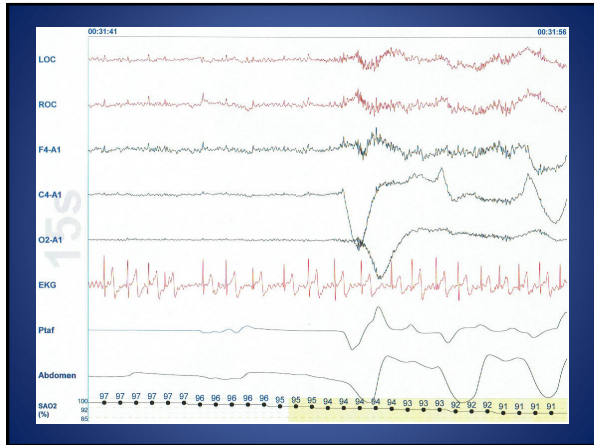
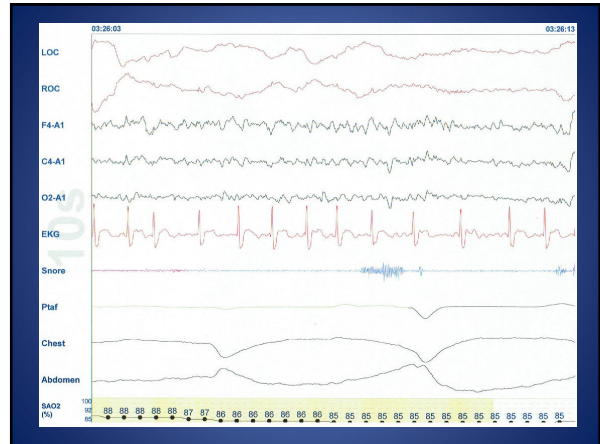


## Case 6 = CHF, arrhythmia

71 y/o m  
CHF, atrial fibrillation, recent hospitalization

Neck Circ = 19 in  
BMI = 35

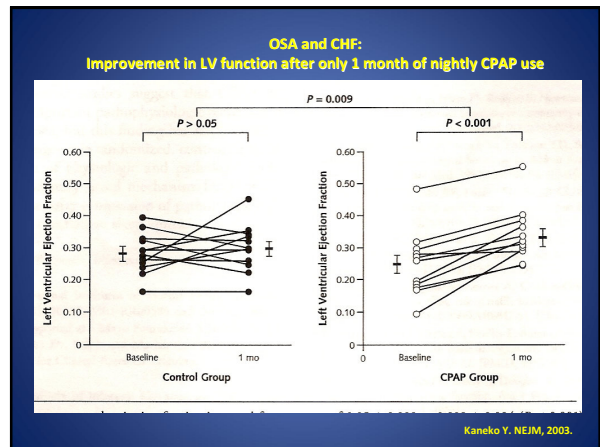
Loud snoring, witnessed apneas



## OSA + CHF

- Circulation 2003;107:1671-1678
- Circulation 2003;107:1822-1826
- SLEEP 2007;30(3):291-304
- AJRCCM 2001(163):19-25
- AJRCCM 1999(160):1101-1106
- SLEEP 2006;29(12):1531-1536
- CHEST 2007;132:843-851
- AJRCCM 2006(173):1300-1308
- AJRCCM 2004(169):361-366
- SLEEP 2007;30(4):468-475

- Obstructive sleep apnea and its cardiovascular consequences. — Lancet. January 3, 2009.
- Obstructive sleep apnea and cardiovascular disease. — Circulation Journal. August, 2009.
- Sleep apnea and cardiovascular disease. — JACC. August, 2008.



**OSA and CHF:  
Improvement in LV function after 3 months of nightly CPAP use**

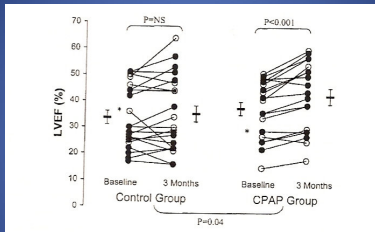


Figure 2. Display of left ventricular ejection fraction (LVEF baseline) and follow-up in control and continuous positive airway pressure (CPAP)-treated groups. Open circles represent idiopathic and closed circles the ischemic cardiomyopathies. There was significant improvement in LVEF in the CPAP group compared with the control group. Patients marked with an asterisk were in sinus rhythm at study commencement and found to be in atrial fibrillation at the end of the study.

**OSA and CHF:  
Improvement in LV function after 24 months of nightly CPAP use**

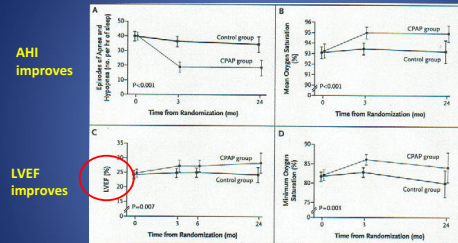


Figure 1. Effect of CPAP on the Frequency of Episodes of Apnea and Hypopnea, Mean and Minimal Nocturnal Oxygen Saturation, and Left Ventricular Ejection Fraction. CPAP resulted in significant long-term reductions in the number of episodes of apnea and hypopnea per hour of sleep (Panel A) and increases in the mean nocturnal oxygen saturation (Panel B), the LVEF (Panel C), and the minimum nocturnal oxygen saturation (Panel D). P-values represent time-treatment interactions over the period of the entire trial (corresponding values for effects at three months appear in the Results section). Circles represent means, and bars represent 95 percent confidence intervals.

CPAP for CHF + CSA, NEJM 2005

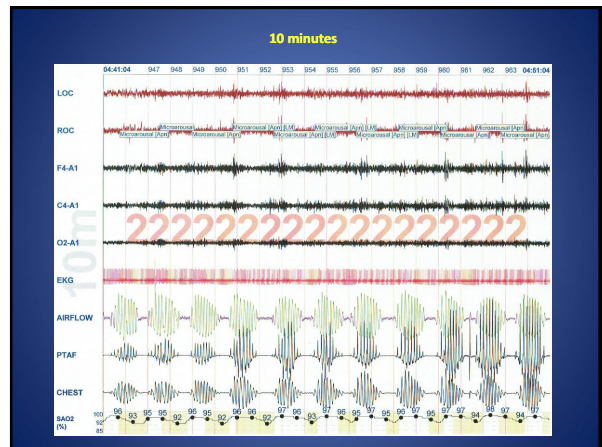
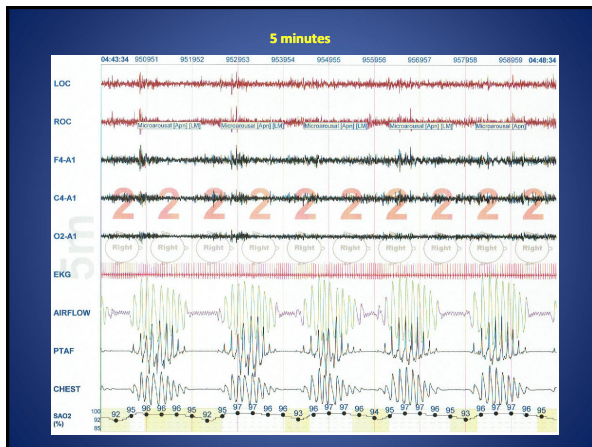
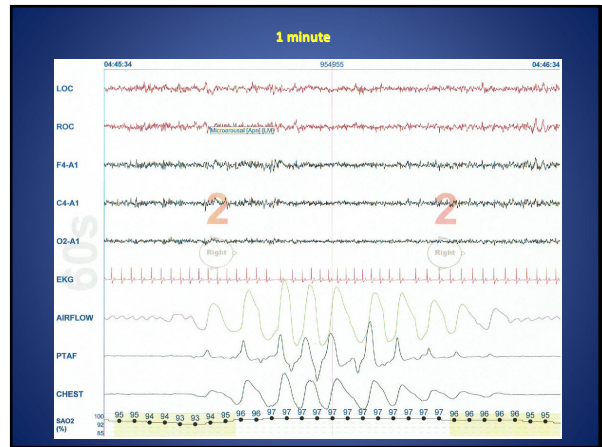
**Case 7 = CHF, cheyne-stokes**

77 y/o m  
CHF, HTN, CAD, recent cardiac rehab

Neck Circ = 18.5 in  
BMI = 33  
ESS = 6 / 24

Loud snoring, dyspnea

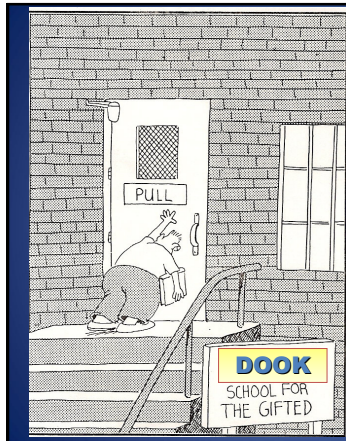
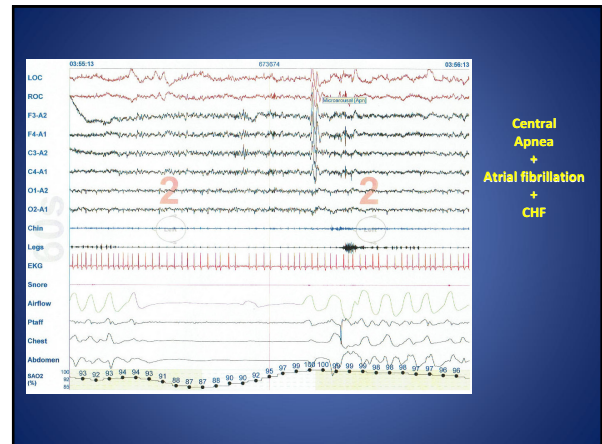
Complex sleep apnea  
AHI = 34 (87%)  
CPAP 16cmH2O



## Case 8 CM, arrythmia, central apnea

44 y/o m  
Dilated cardiomyopathy  
EF < 25%

Neck Circ = 20in  
BMI = 32  
ESS = 15 / 24



## Conclusion - 2

Sleep and oxygen are good for you.

## Alternatives to CPAP

## Case 9 = alternative to CPAP

51 y/o m

- Primary Care

CC:

- "insomnia x2 yrs"  
– Trazodone qhs

PE:

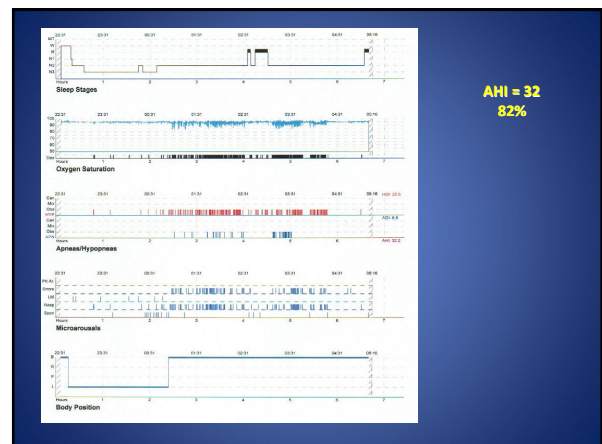
- Neck Circ = 15 in, MP I
- Ht = 6' / Wt = 168 lbs

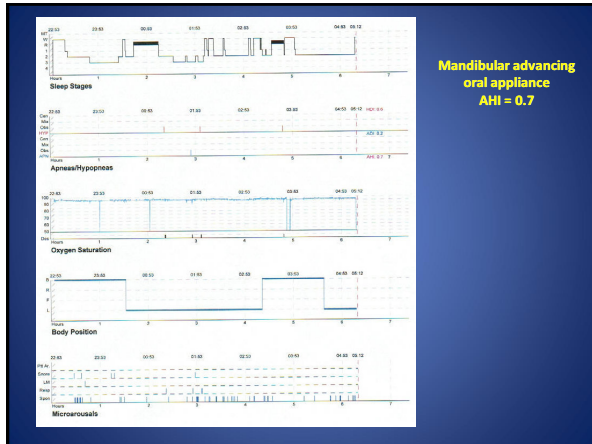
Sxs:

- snoring, frequent arousals, "choking" during sleep

Meds:

- Prozac 20mg qam x5 yrs





**SomnoDent<sup>®</sup>**  
DESIGNED FOR SLEEP

**Oral Appliance Therapy  
(mandibular advancement)**

**Robert Kulp, Jr. D.D.S.**

The comfortable, effective, custom treatment for Obstructive Sleep Apnea.

Ask your physician or dentist for more information.

**HGNS – The Future of Therapy for OSA?**  
[www.sleepapneatrial.com](http://www.sleepapneatrial.com)

[www.APNEXmedical.com](http://www.APNEXmedical.com)

**Treating Obstructive Sleep Apnea with Hypoglossal Nerve Stimulation**

**Introduction**

The hypoglossal (XII) cranial nerve is a motor nerve that originates in the brainstem and innervates the tongue and larynx. Stimulation of this nerve causes the tongue to protrude, which helps to keep the airway open during sleep.

**Methods**

Study Design: Single arm, open label, evaluation at 4 treatment sites.

Study Population: 22 patients (14 males, 8 females) with moderate to severe OSA (AHI > 10, CPAP < 4 hours/night).

Primary Endpoints: Mean change from baseline in obstructive apnea (AHI) and CPAP at 4 and 8 weeks.

**Results**

Patients were followed for 12-week nights (range 10-12 weeks).

Patients who used a mean of 80% of nights longer than 4 hours had a mean AHI of 10.7.

The mean obstructive apnea events per hour (OAE) were 10.7 (range 2-24) at baseline and 4.1 (range 0-10) at 4 weeks.

**Table 1: Polysomnography**

Parameter	Baseline	4 Weeks	8 Weeks
AHI	10.7	4.1	3.2
CPAP (hours/night)	3.2	4.1	4.8
SpO2 < 90% (hours/night)	1.2	0.8	0.6
REM Sleep (hours/night)	1.8	1.8	1.8
REM AHI	12.5	4.5	3.5
REM CPAP (hours/night)	2.5	3.5	4.2
REM SpO2 < 90% (hours/night)	1.0	0.7	0.5
REM Sleep (hours/night)	1.8	1.8	1.8
REM AHI	12.5	4.5	3.5
REM CPAP (hours/night)	2.5	3.5	4.2
REM SpO2 < 90% (hours/night)	1.0	0.7	0.5

**CONCLUSIONS**

Treatment of OSA with the hypoglossal (XII) cranial nerve stimulation (HGNS) system is safe and effective in the treatment of moderate to severe OSA. Patients who used a mean of 80% of nights longer than 4 hours had a mean AHI of 10.7.

**Conclusions**

**Summary = anyone can have apnea...**

Dr. Thomason is my hero!

**and apnea has significant CV risks....**

**General**

- 15 million Americans with OSA
- Most do NOT know that they have this...

**HTN**

- 50% of OSA pts have HTN
- 30% of HTN pts may have OSA
- Pts with more severe OSA: difficult to control BP, and better CPAP compliance do the best

**Heart Failure**

- 11 - 37% of CHF pts have OSA
- Less often c/o sleepiness
- Men > women
- > 50% with diastolic failure

**Stroke**

- Difficult to study without bias (survivors)
- Higher incidence immediately afterwards
- AHI > 20 may be higher risk
- 10 yr I/u after stroke shows higher mortality in pts with OSA

**Arrhythmias**

- 50% of OSA pts have display some type
- Non-sustained V-Tach, sinus arrest, 2<sup>nd</sup> degree av-block, frequent PVCs (>2 per min)
- 4x risk for atrial fibrillation
- 82% of recurrence in 1 year after cardioversion if left untreated
- Half that % if treated with CPAP
- Increased risk for sudden cardiac death in the early morning hours (NEJM)

**Pulmonary HTN**

- AHI > 20 = 20%
- Usually mild, rare to have PAP > 35mmHg

**End Stage Renal Disease**

- Small series, 40-60%

