

Is AHI the Optimal Outcome Measure in OSA?



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Disclosures

Siesta Medical

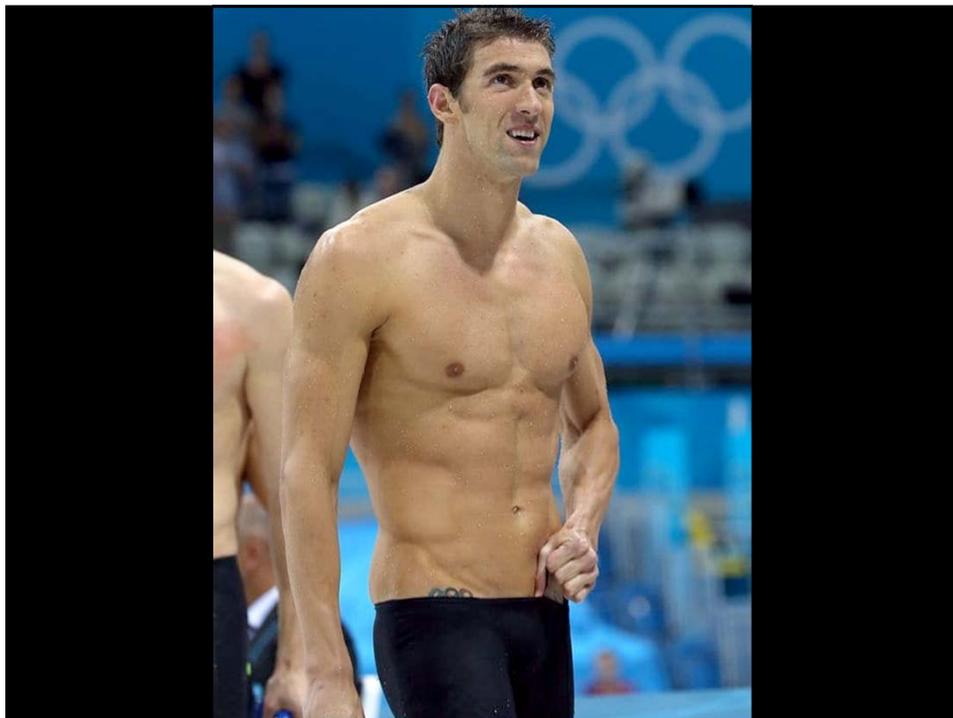
Minor stock holder – sleep apnea device

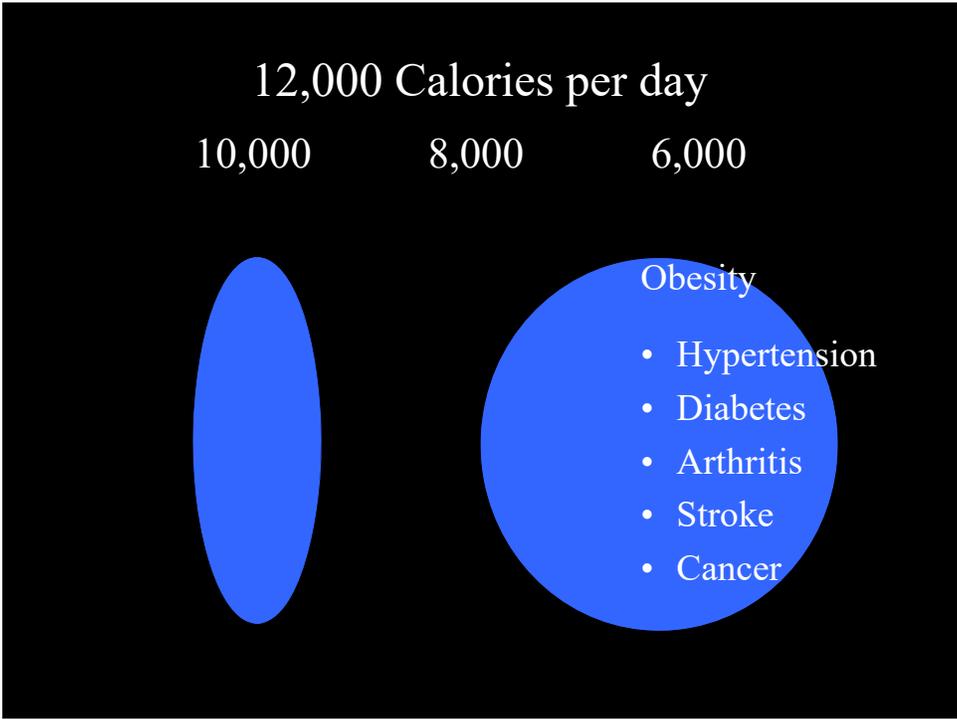
Patent Pending 61/624,105

Sinus diagnostics and therapeutics



12,000 Calories per day





AHI

Definitions of Disease

- Sleep Disordered Breathing - Recurrent episodes of cessation of respiration (apnea) or decrements in air flow (hypopnea) which may disrupt sleep

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Definition of Apneic Events on PSG

- Apnea - Cessation of breathing during sleep for >10 sec
- Hypopnea - Decrease in air flow of >50% associated with a fall in SaO₂ >4% +/- EEG arousal
- Apnea Hypopnea Index (AHI) - The number of apneas + hypopneas per hour of sleep; add RERAs/hour to get the Respiratory Disturbance Index (RDI)

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Polysomnography measures

- How well do PSG measures correlate with other measures?
- Weaver 2005
 - Analyze PSG/non-PSG measures in mild-moderate OSAS
 - FOSQ, SNORE, SF-36, ESS, PVT
 - No significant association between AHI and any baseline or outcomes non-PSG measure
 - Conclusion: PSG measures do not capture all elements of OSAS and should not be used exclusively to evaluate treatment response

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PSG and Tiredness from Sleep Heart Health Study

- Analysis of 1115 patients in the SHHS Kapur 2005
- AHI > 15 45.7 % of patients with were sleepy
- AHI > 30 51.4% of patients with were sleepy
- AHI did correlate with sleepiness ($p < .01$)

sleepy patients

AHI 31.6

Statistically significant, but clinically significant?

Not very discriminating for the clinician

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Is Self Reported Tiredness Important??

- Does self reported sleepiness by ESS modify the association between sleep apnea and hypertension?

Yes!

Kapur 2008

- Odds ratio for H/T if sleepy 2.83
- Odds ratio for H/T if NOT sleepy 1.22

Where is sleepiness in the definition of SDB???

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Is AHI the “Holy Grail” for OSA Assessment?

- Assumes Apnea and Hypopnea are the same
 - Lack of evidence of clinical impact does not necessarily obviate the concern
- Cyclical hypoxemia provides clinical impact
 - however 4% and 10% drops are counted the same
- AHI computation neglects distribution of events
 - Clustered versus distributed events treated the same
- Hypopnea definition is subject to “seasonal change”...
 - Lack of agreement on standard definition
 - Hypopnea of 10s and 2 minutes are counted equally

Punjabi Chest 2016

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Is AHI the best we have?

Limitations of AHI in defining the complexity of SDB are clear...

“However, to date (somewhat surprisingly), none of the attempts to improve on the AHI has produced improved results” Rapoport Chest 2016

POINT:
Is the Apnea-Hypopnea Index
the Best Way to Quantify the
Severity of Sleep-Disordered
Breathing? Yes

David M. Rapoport, MD, FCCP; New York, NY

CrossMark

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What metrics are available?

- PSG
- Cardiovascular morbidity
- Cognitive function / motor vehicle accidents
- Other physiologic / metabolic parameters

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Consensus Statement on Treatment Criteria in OSA

Daniel I. Loube, MD, FCCP; Peter C. Gay, MD, FCCP
Kingman P. Strohl, MD, FCCP Allan I. Pack, MD, PhD
David P. White, MD, FCCP Nancy A. Collop, MD, FCCP
CHEST 1999; 115:863– 866

CPAP treatment

All patients with an AHI>30, regardless of symptoms

For patients with an AHI of 5 to 30 w/ symptoms or co-morbidities
excessive daytime sleepiness, impaired cognition, mood
disorders, insomnia, or documented cardiovascular diseases to
include hypertension, ischemic heart disease, or stroke

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Defining common outcome metrics in OSA

Al-Shawwa Sleep Med Rev 2008

Redefining successful therapy in OSA:

A call to arms

Pang Laryngoscope 2014

Outcome measurements on OSA:

Beyond the AHI

Tam Laryngoscope 2014

Treatment Guidelines

“In the majority of patients without coexisting conditions...the primary reason to test for and treat sleep apnea is the potential to improve the quality of life”

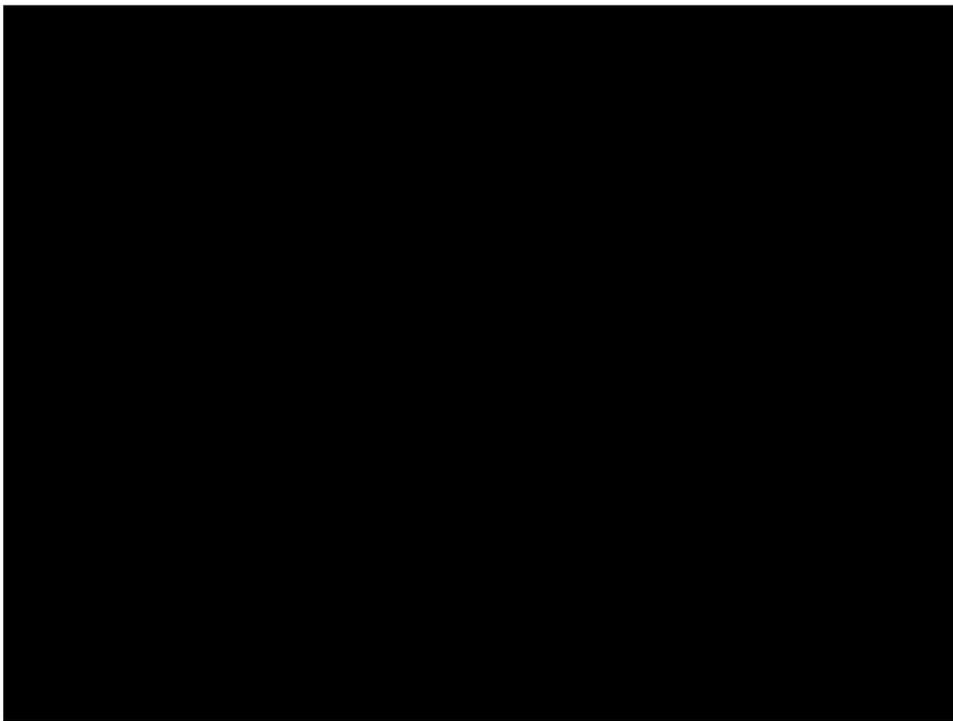
Flemons NEJM 2002

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Conclusions

- We need to demote AHI from “Gold Standard”
- We don’t want to throw our AHI entirely, but use it rationally
- New metrics are needed in research and clinical practice
Rapoport Chest 2016
- Particularly for the middle range of patients, AHI should be integrated into a more comprehensive assessment of severity, differential susceptibility, and treatment goals

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Treatment “Effectiveness”

- Haraldsson tested patients with SDB and normals on a driving simulator (at the Saab factory)
- Performed UP3 on patients with SDB
- Found that patients w/ SDB uniformly improved after UP3
REGARDLESS OF CHANGES IN AHI
- Did these patients with improved alertness and no change in AHI FAIL treatment? Haraldsson 1995

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Snoring

- Subjective spouse measures
 - Surrogate measure with VAS, “bother scale”, etc
- Objective sound measurements
 - difficult, but possible, to quantify
- SNAP frequency analysis
 - analyzes snoring frequency and amplitude algorithm proprietary

Liesching 2004

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Cardiovascular Disease (SHHS)

- Heart failure, stroke Shahar 2001
- Right Heart Function Dursunoglu 2006
- Ischemic changes in the brain Ding 2004
 - Arousals, not AHI
- Association with Hypertension
 - Could not correlate with PSG parameter Redline 2005
 - Higher incidence of HT in sleepy patients Kapur 2008

<http://www.jhuuct.com/shhs/>

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Neurophysiologic Effects - testing

- Attention is impaired
 - PVT (reliable, no learning, sensitive) Balkin 2004
- Vigilance and cognitive functioning impaired
 - Intellectual and verbal functioning relatively spared
 - These improve with treatment (CPAP)

Beebe 2003
- Cognitive function testing does not correlate w/ AHI Boland 2002
(SHHS)

Cognitive Function - patient report measures

- **Epworth Sleepiness Scale** Johns 1991
 - 0-24 scale for “chance of dozing”
 - Average if 7 for medical students, 14 for OSA patient
- **Functional Outcomes of Sleep Questionnaire (FOSQ)** Weaver 1997
 - Measures impact of sleepiness on functioning
- **Calgary Sleep Apnea Quality of Life Index** Flemons 1997
 - Captures QOL, performance, mood
- **Stanford Sleepiness Scale** Hoddes 1973
 - Measure of sleepiness on a 1-7 scale meant to be used at different times during the day for comparison

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Metabolic measures?

- **Inflammatory**
 - Elevated IL-6, TNF-alpha, CRP O2 radicalsSchultz 2000
Teramoto 2003
- **Hormonal changes**
 - fT4, testosterone, LH, SHBGMeston 2003
- **Diabetes, ILGF-1, sympathetic tone**
- **Ischemic changes in the brainstem**
 - related to arousals, but not apnea or hypopneaDing 2004

Metabolic Changes with Treatment

- CRP decreases in compliant CPAP users n=20
 - Level decreased a mean of 1.4 mg/l
 - Endothelial function improved as well
 - No change in 6 non-compliant patients
- CRP decreases in responders to multilevel surgery n=30
 - Level decreased a mean of 1.02 mg/l
 - No change in 17 non-responders
 - Improvements in HRQL in responders and non-responders

Panoutsopoulos 2012

Kezirian 2010

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Polysomnography Measures

- Multiple measures possible, a few are popular
 - Apnea Hypopnea Index (AHI)
 - Respiratory Disturbance Index (RDI)
 - Minimum O₂ Saturation
 - Arousals
 - Time in REM sleep
 - Total apnea time
 - Total sleep time below 90% saturation

Does a polysomnogram alone define this disease?

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Effects of Sleep Disordered Breathing (SDB)

- Physiologic
 - Increased incidence of MI, CVA, H/T
- Behavioral / Cognitive
 - Daytime sleepiness, increased MVA incidence up to 7x
 - MVA risk in men evident w/ snoring alone w/o OSA Young 1997
- Social
 - Snoring, disruption of marital harmony

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Definitions of Disease by PSG

- Obstructive Sleep Apnea (25% males, 9% females, Young 1993)
 - AHI >5 events/hour
- Obstructive Sleep Apnea Syndrome (4% m, 2% f, Young 1993)
 - AHI >5 events/hour with symptoms (eg. daytime sleepiness)
- Upper Airway Resistance Syndrome
 - Repeated arousals 2⁰ to upper airway resistance or snoring

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