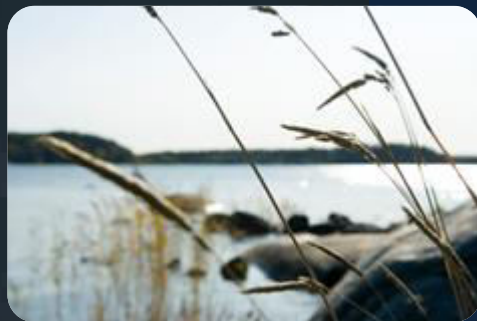




**NEW MEXICO
62ND ANNUAL FAMILY
MEDICINE SEMINAR**

AUGUST 1, 2019

RISE OF THE MACHINES

FRANK M. RALLS M.D.

ASSOCIATE PROFESSOR INTERNAL MEDICINE

UNM PROGRAM DIRECTOR: SLEEP MEDICINE FELLOWSHIP

UNIVERSITY OF NEW MEXICO

ALBUQUERQUE, NEW MEXICO

Type of Potential Conflict	Details of Potential Conflict
Grant/Research Support	
Consultant	
Speakers' Bureaus	
Financial support	
Other	

NONE

I do not have any relationships with any entities producing, marketing, re-selling, or distributing health care goods or services consumed by, or used on patients.



Obstructive Sleep Apnea (OSA)

Objectives

► Key Points:

- OSA and CSA cause significant morbidity and mortality
- Special populations that develop OSA and CSA
- Various treatment options for OSA
- “Rise of the Machines”



Rapid Eye Movement Sleep (REM)

Starts 28-30 weeks gestational age

80% of TST

50% at birth for 3 months



Figure 3: Hypnogram from a 1-month old infant depicting large amount of REM (> 50% of total sleep time). Black regions represent REM sleep.

Title: Infant REM (active) sleep

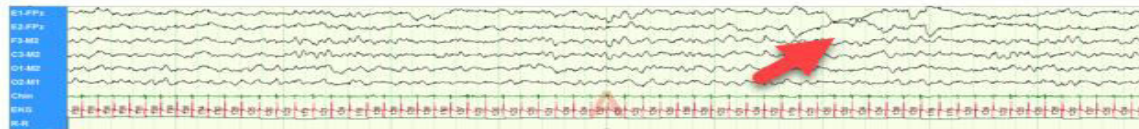
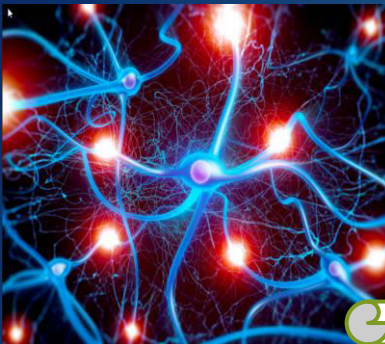


Figure 1: This is a 30-second epoch of REM or active sleep in a 1-month old infant. Note the rapid eye movements in the top 2 channels (arrow) and low chin tone. REM sleep consists a low amplitude, and mixed frequency EEG background.

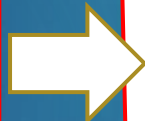


**Neuronal:
Development
Mapping
Plasticity**



**Spinal Cord
Sensorimotor
Cortex**

**Brainstem
(Red Nucleus)**



**Twitches
(REM =Active Sleep)
Precisely Timed Oscillatory
Activity**



**Sensory
Feedback**



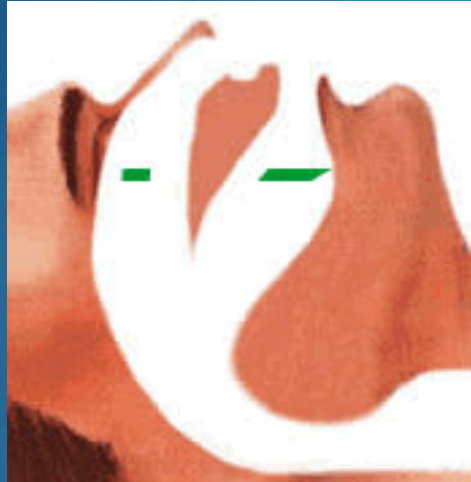
REM Sleep and Neuronal Development



- ▶ REM sleep strengthens adaptive memory traces.
- ▶ Sleep apnea disrupts REM.

Abad, Curr Top Behav Neurosci, 2015, Puentes-Mestril, Front Neural Circuits, 2017, Almeida-Filho, Cell Mold Life Sci, 2018

Obstructive Sleep Apnea (OSA): Airway Collapses with Inspiration



Normal breathing



Obstructive Sleep Apnea

Patient with OSA

Sleep

Apnea

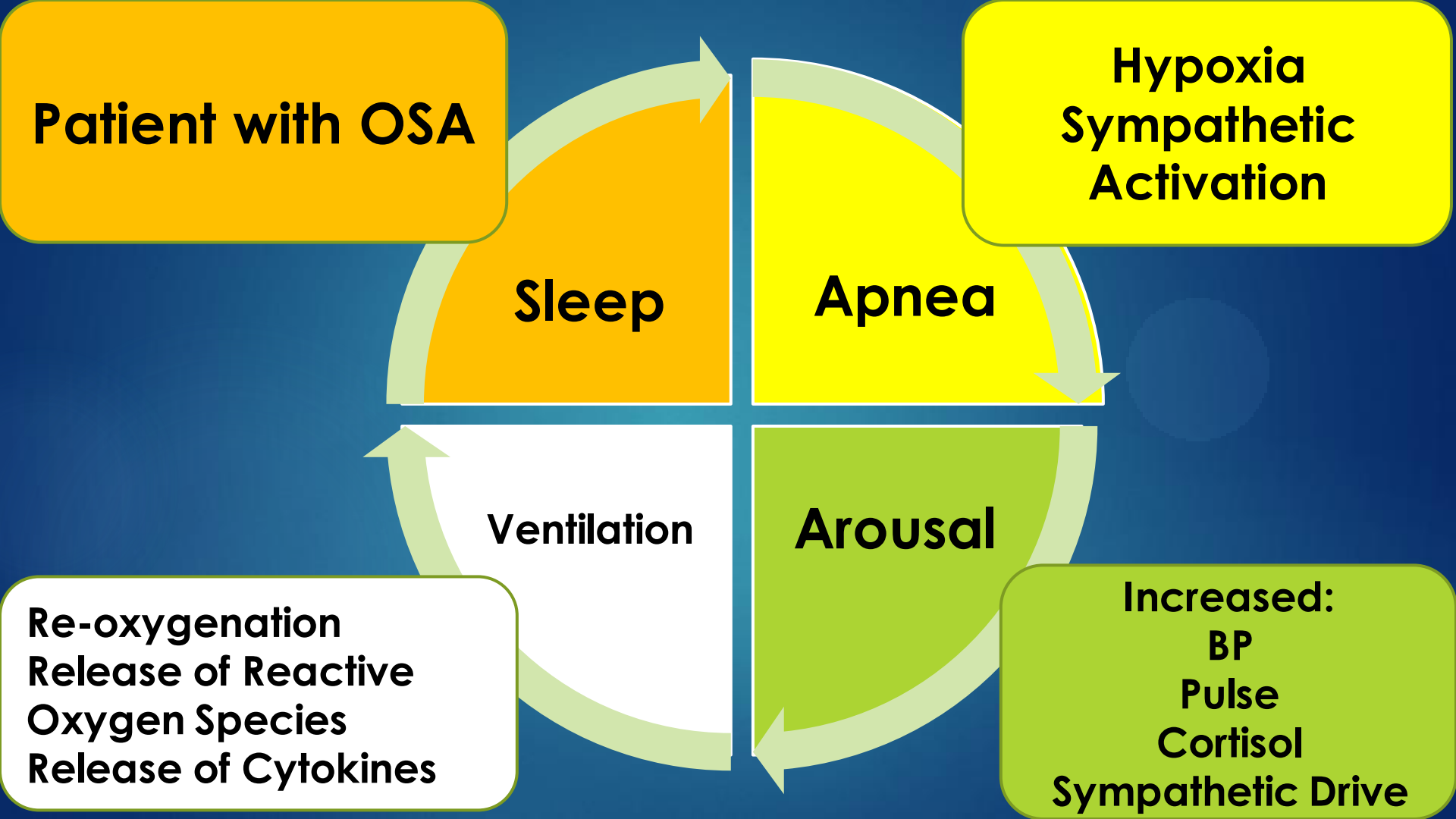
**Hypoxia
Sympathetic
Activation**

Ventilation

Arousal

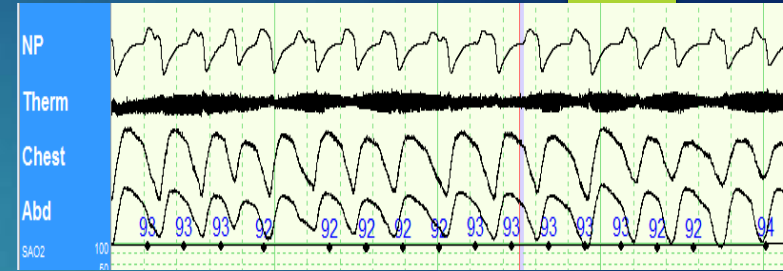
**Re-oxygenation
Release of Reactive
Oxygen Species
Release of Cytokines**

**Increased:
BP
Pulse
Cortisol
Sympathetic Drive**

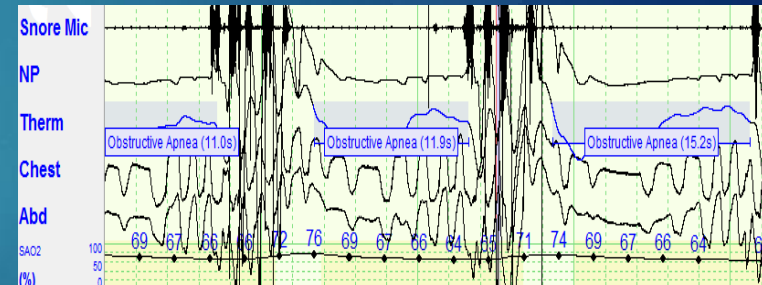


Apnea-Hypopnea Index (AHI)

- ≥ 10 seconds in length
- < 5 per hour = normal
- **5 - 14** per hour = mild sleep apnea
- **15 – 29** moderate
- ≥ 30 severe sleep apnea.

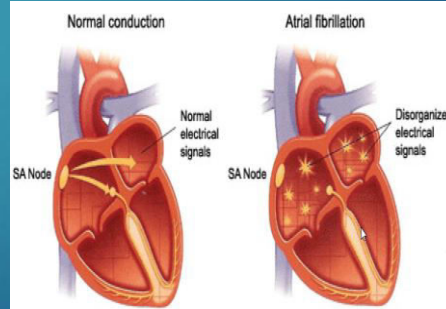
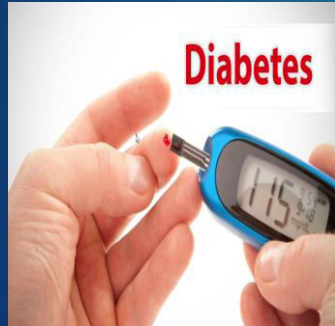


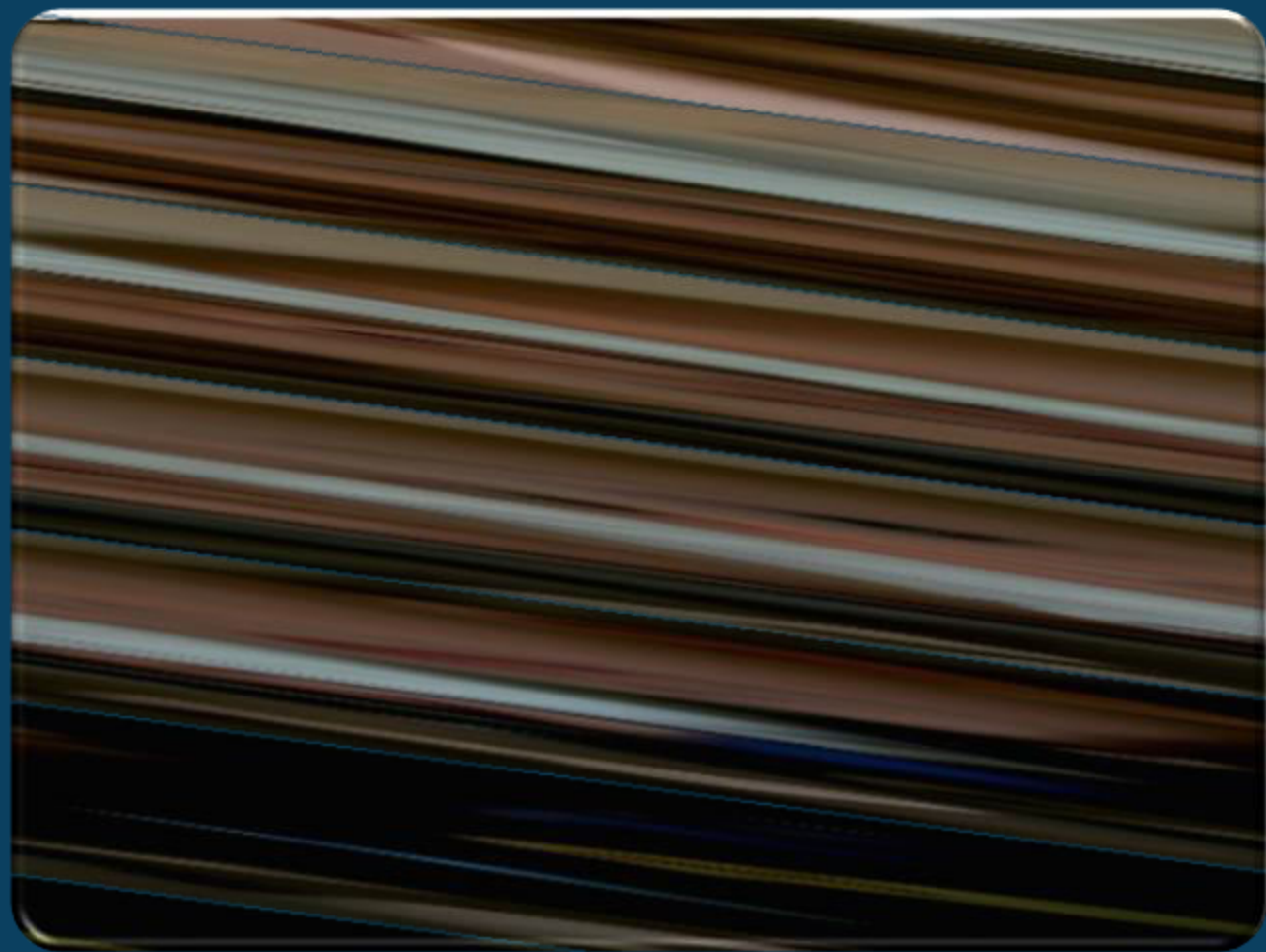
Normal breathing



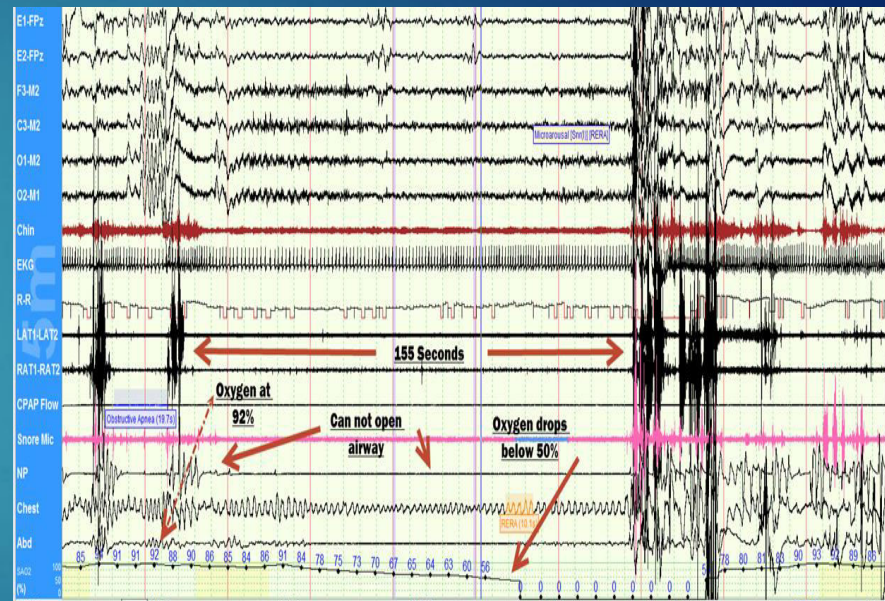
Obstructive apneas

OSA PRESENTING SYMPTOMS



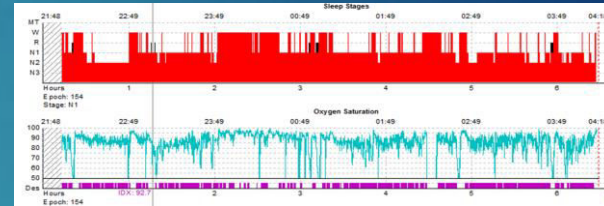
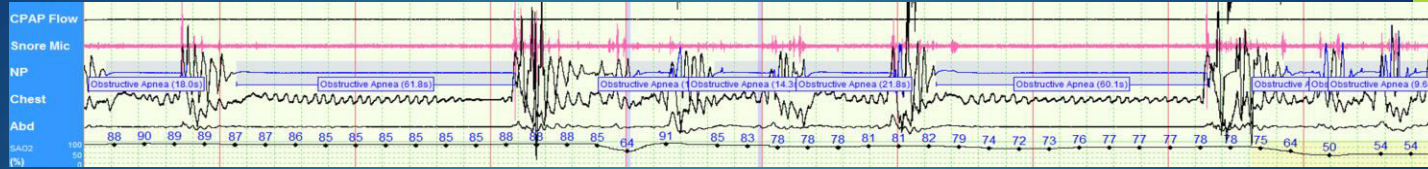


Severe Obstructive Sleep Apnea

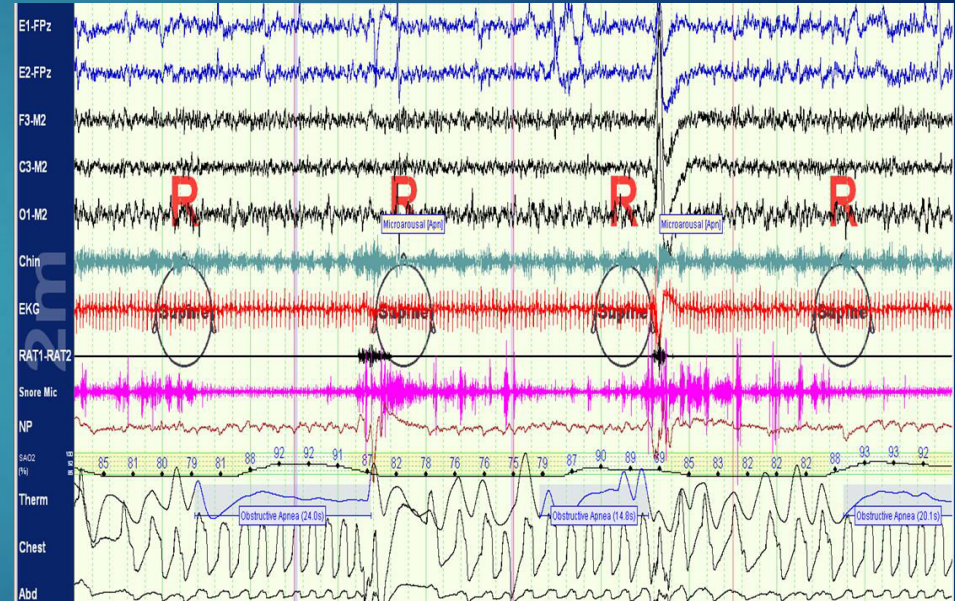


155 seconds without opening airway

Obstructive Sleep Apnea

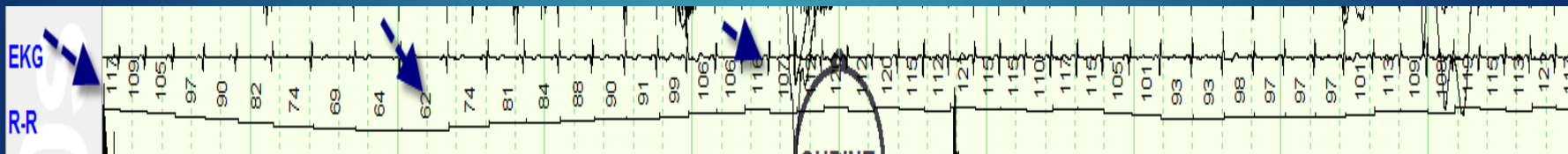


Children Obstructive Sleep Apnea



Sympathetic Surge

- Sustained elevated heart rate > 85 during sleep is an independent predictor of sudden death in middle aged men.



Sympathetic activation: may cause SBP to increase up to 240 mm Hg at termination of apnea.

Nocturnal Dipping Declines in Untreated OSA

- ▶ Blood pressure normally drops 10-20% when sleeping

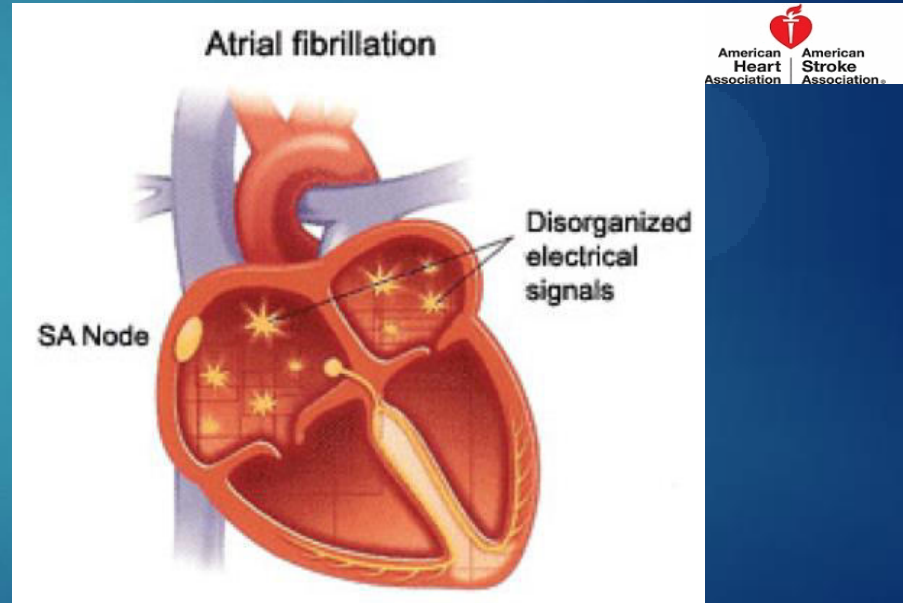


- ▶ HTN

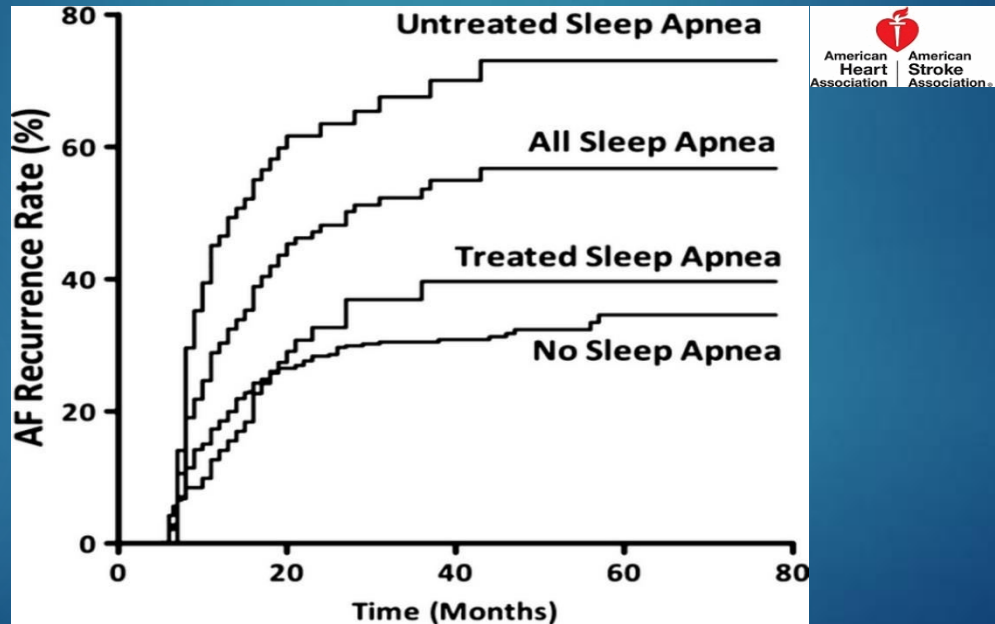
- 3 meds – 10-20% AHI > 30
- 5 meds – 70-90% AHI > 40
 - More common in women and African Americans
- Sudden cardiac death peaks between 12-6 AM

OBSTRUCTIVE SLEEP APNEA AND ATRIAL FIBRILLATION

- ▶ OSA: Independent risk factor for AF
- ▶ Cardiac remodeling
 - ▶ Increased intrathoracic pressure
 - ▶ Ventricular hypertrophy
 - ▶ Left atrial stretch

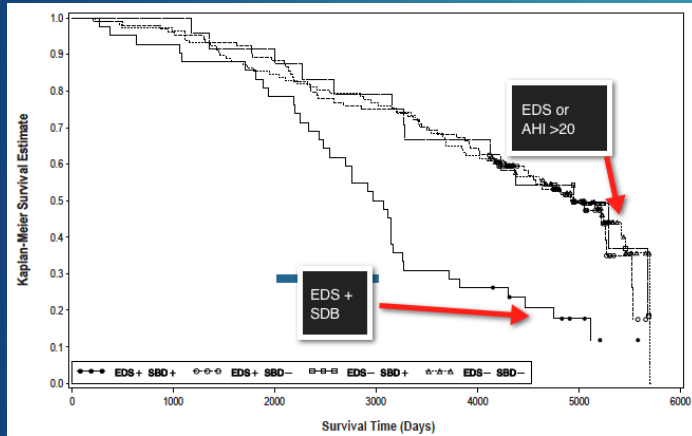


OBSTRUCTIVE SLEEP APNEA AND ATRIAL FIBRILLATION (Risk 2-4X Increase)



Tomas G. Neilan et al. J Am Heart Assoc
2013;2:e000421

Sleep Apnea in the Elderly??



- ▶ Reduced ventilatory drive because of reduced sensitivity to both oxygen and CO₂
- ▶ Phenotype

American Academy of Sleep Medicine (AASM)

Patients who should be evaluated for OSA.

Obesity (BMI > 35)

Congestive heart failure

Atrial fibrillation

Treatment refractory hypertension

Type 2 diabetes

Nocturnal dysrhythmias

Stroke

Pulmonary hypertension

High-risk driving population

Preoperative for bariatric surgery

SCREENING FOR OSA BY AGE

Children



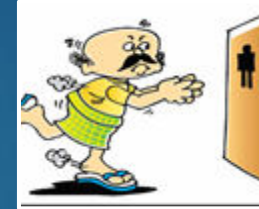
- **Large Tonsils**
- **Secondary Enuresis**
- **Behavioral**

Adults



- **Excessive Daytime Sleepiness**
- **Apnea**
- **Loud Snoring**
- **Hypertension Requiring ≥ 3 Medications**

Elderly



- **Excessive Daytime Sleepiness**
- **Poor Sleep Quality**
- **≥ 3 times per night to urinate**

SCREENING FOR OSA

GENDER DIFFERENCES IN ADULTS

MALES

- WITNESSED APNEIC EVENTS
- SNORING

FEMALES

- MOOD DISTURBANCES
- MORNING HEADACHE
- FATIGUE
- INSOMNIA

Screening For Obstructive Sleep Apnea

Answer each of the following "yes" or "no":

S
T
O
P
B
A
N
G

Do you **SNORE** loudly (louder than talking or loud enough to be heard through closed doors)?

Do you often feel **TIRED**, fatigued, or sleepy during daytime?

Has anyone **OBSERVED** you stop breathing during your sleep?

Do you have or are you being treated for high blood **PRESSURE**?

BMI more than 35?

AGE over 50 years old?

NECK circumference > 15.75 inches?

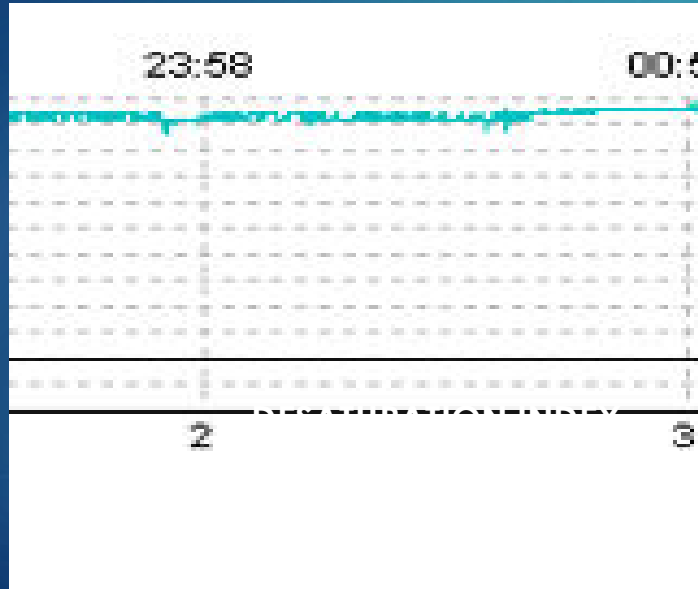
Male **GENDER**?

≥ 3 "yes" answers = High-risk for OSA

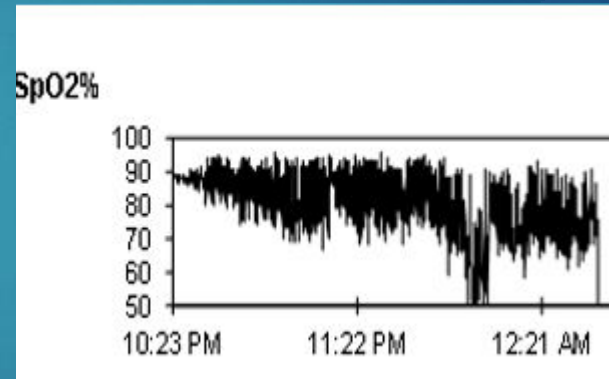
< 3 "yes" answers = Low-risk for OSA

Oximetry: Good Screening Test

Normal



Sleep Apnea





OSA vs CSA



OSA:

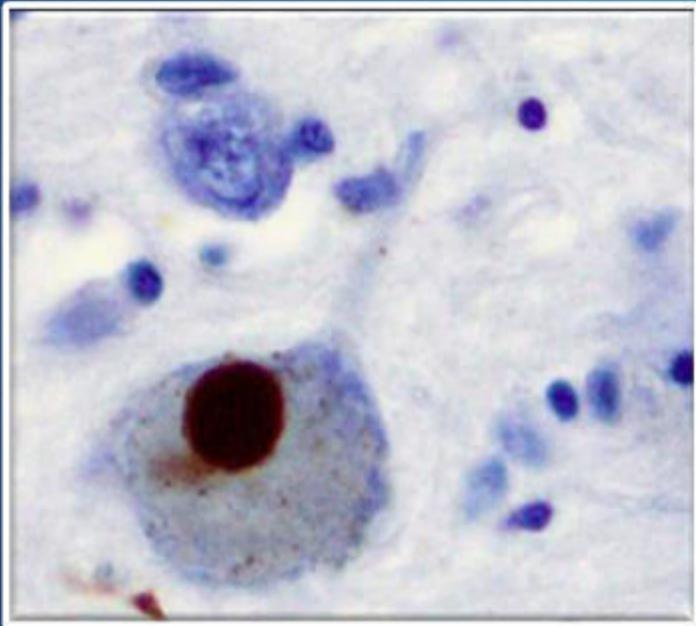
The aim of therapy is to stabilize the upper airway.

CSA:

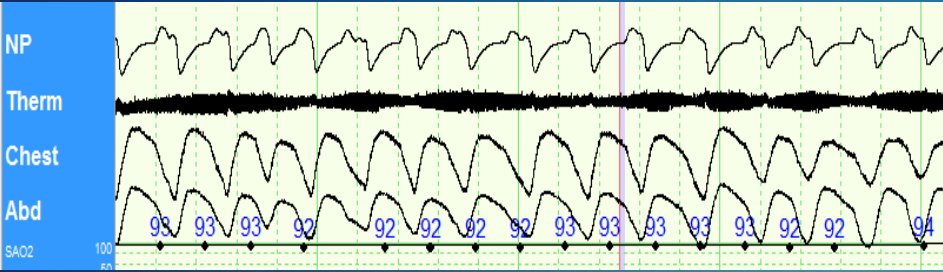
The aim of therapy is to stabilize ventilation.

SPECIAL POPULATIONS AND SLEEP APNEA

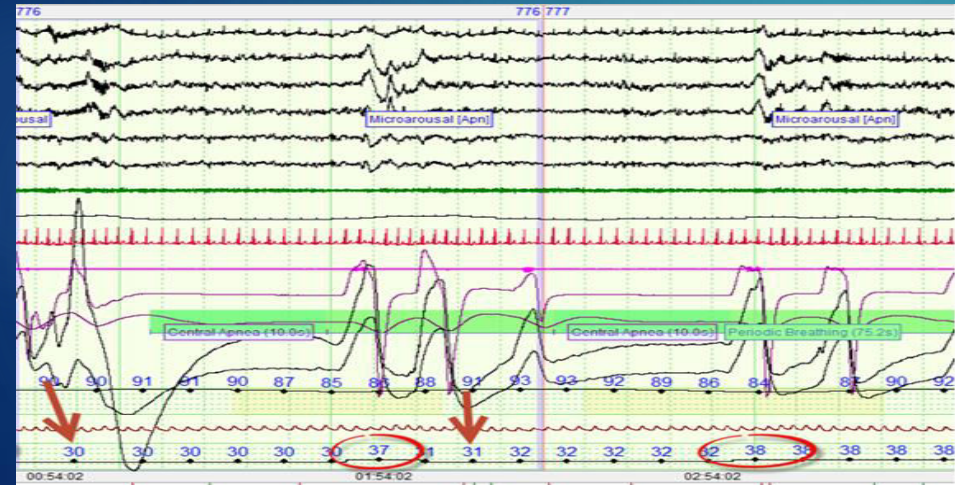
- Medullary respiratory centers in the medulla Control Non-REM Sleep



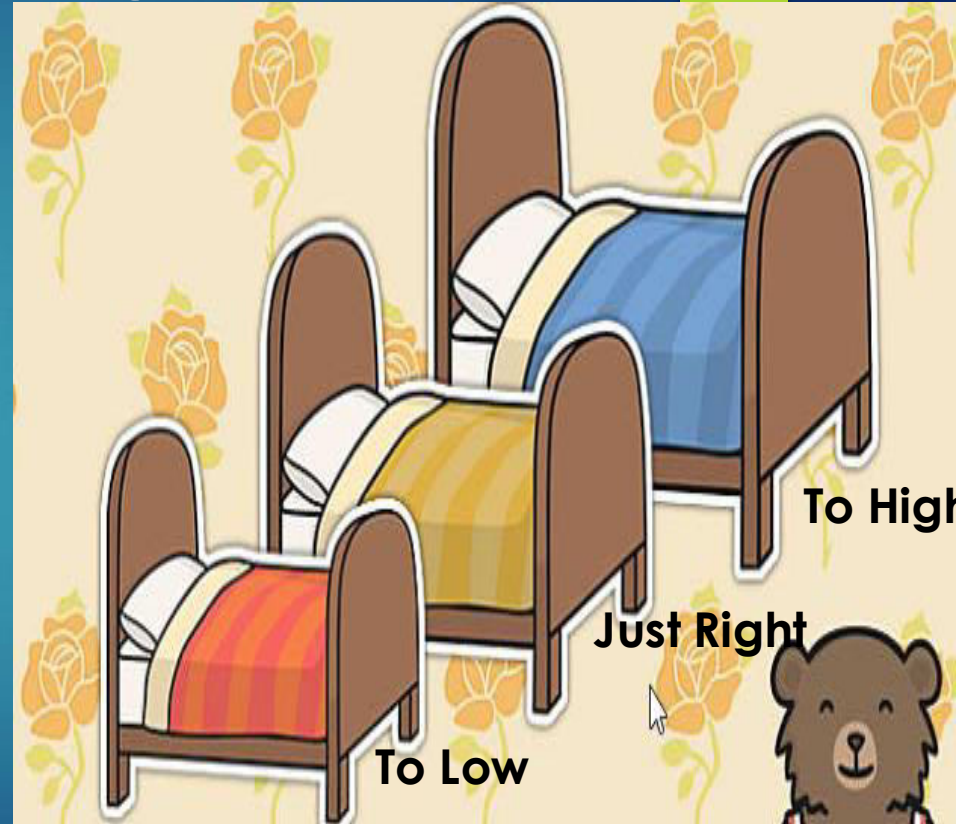
Page 10 of 10



Normal breathing



Central apneas



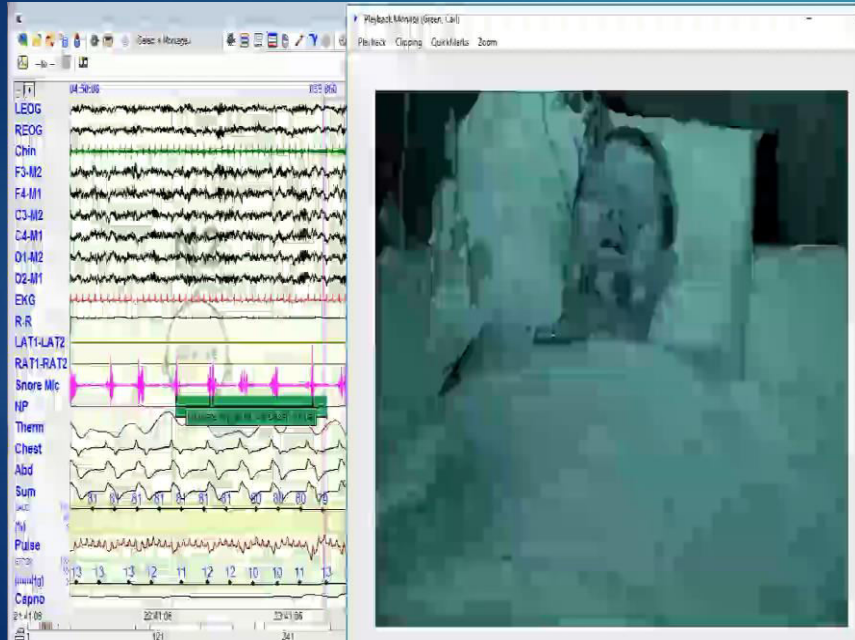
SPECIAL POPULATIONS AND SLEEP APNEA

Multiple System Atrophy (MSA)

29

High-pitched inspiratory sound, due to a laryngeal narrowing.

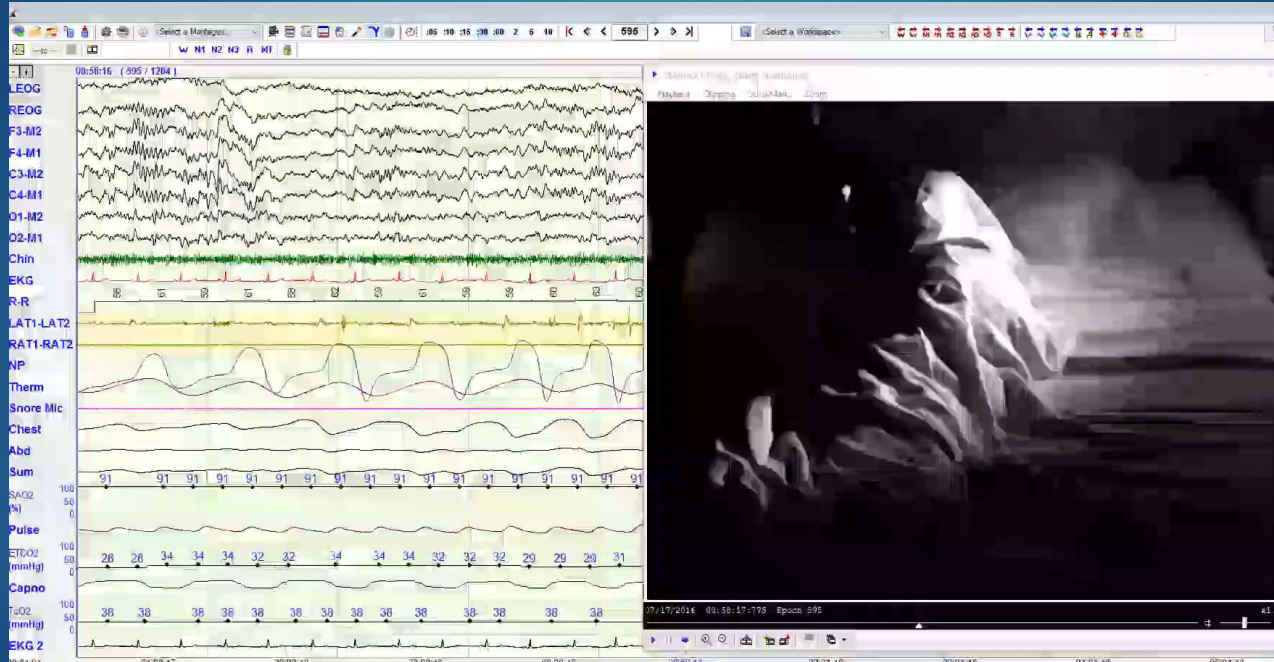
Copyright
Lippincott



SPECIAL POPULATIONS AND SLEEP APNEA

Multiple System Atrophy (MSA)

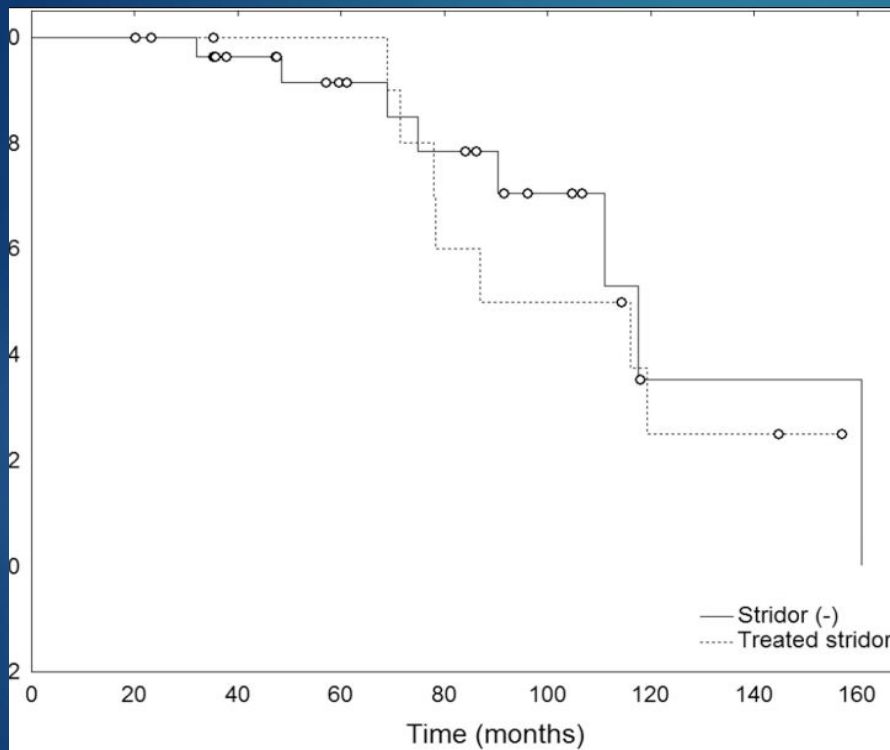
30



Copyright © 2009 Wolters Kluwer. Published by Lippincott Williams & Wilkins.

SPECIAL POPULATIONS AND SLEEP APNEA

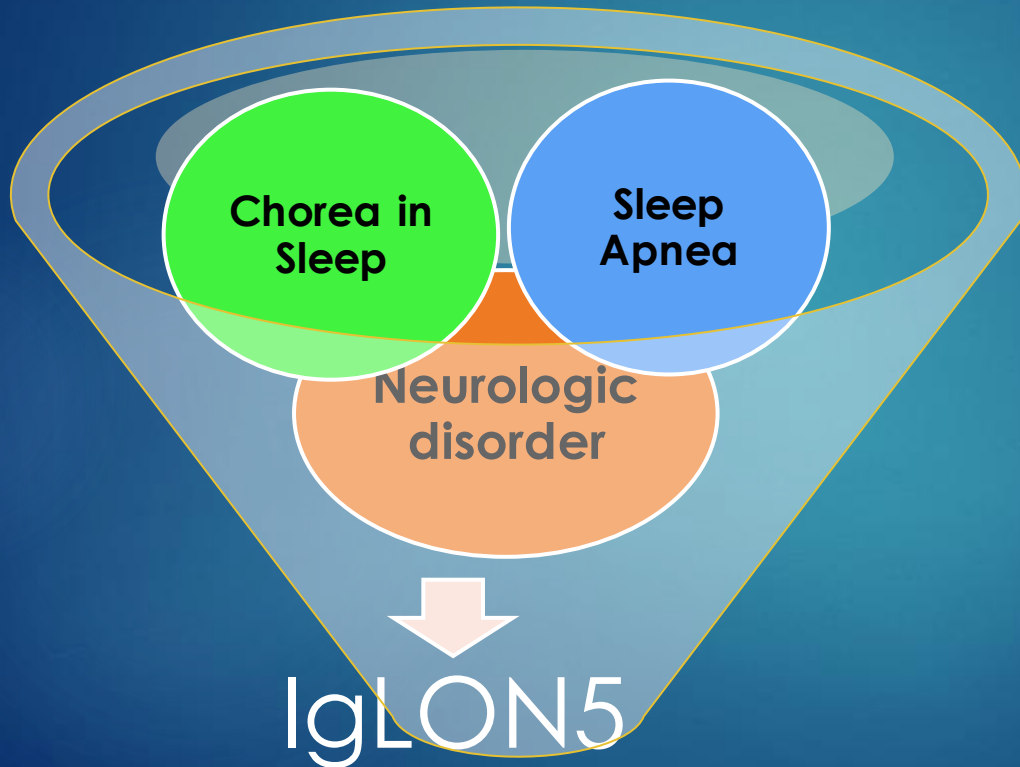
MSA and Stridor



- ▶ Tracheostomy did not provide significantly longer survival compared to APAP and ASV.
- ▶ Note: as disease progresses, central sleep apnea (CSA) develops. A tracheostomy does not prevent CSA.

SPECIAL POPULATIONS AND SLEEP APNEA

Anti-IgLON5 Autoimmune Neurodegeneration



- ▶ 2014
- ▶ IGLON5: a neuronal cell adhesion protein of unknown function
- ▶ A case of autoimmunity and neurodegeneration
- ▶ Atypical tauopathy

Montejo et al. Mov Dis 2016
Gaig et al., Neurology 2017

SPECIAL POPULATIONS AND SLEEP APNEA

Anti-IgLON5 Autoimmune Neurodegeneration

- ▶ Neurological presentation may vary greatly

Neurological exam

IgLON5 antibodies

SPECIAL POPULATIONS AND SLEEP APNEA

Anti-IgLON5 Autoimmune Neurodegeneration

- ▶ 45 yo with 1-year history of confusion and disorientation.
- ▶ Unable to identify relatives
 - ▶ (Normal MRI)
- ▶ Dysphagia
- ▶ Sleep:
 - ▶ Stridor
 - ▶ Myoclonus
 - ▶ Semi-purposeful movements
 - ▶ OSA and CSA



SPECIAL POPULATIONS

IgLON5 Encephalopathy: Case Report

Patient Presented with Cognitive Impairment, Chorea, and OSA

Diagnosis

- ▶ CSF: elevated total protein, IgG and albumin without pleocytosis
- ▶ Polysomnogram:
 - ▶ PLMI was 75/hour
 - ▶ OSA-AHI 58
 - ▶ No REM sleep

Treatment

- ▶ Improvement with 8 months of IVIg

SPECIAL POPULATIONS AND SLEEP APNEA

Anti-IgLON5

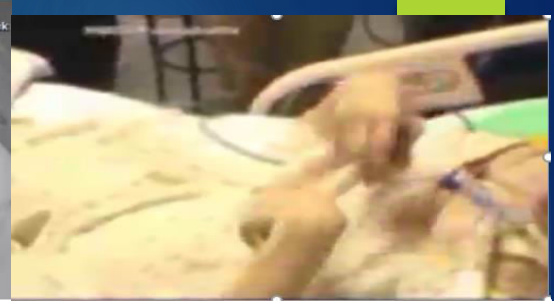


Anti-NMDAR Encephalitis

Video Segment 1

NMDA-receptor antibodies encephalitis

Unintelligible speech and semi-purposeful movements in the hands



Characteristics	Autoimmune neurodegeneration	Anti-NMDAR encephalitis
	<u>Autoimmune neurodegeneration</u>	Autoimmune encephalitis
Acquired clinical syndrome with recognizable features	Sleep disordered breathing Cognitive decline Movement in sleep	Psychosis, agitation, seizures
Presentation	Adults	Children and young adults
Neuropathology	Hyperphosphorylated tau	IgG deposition
Response to immunotherapy	No response in the majority	Varied

WHICH ONE IS A HOME SLEEP TEST



1



2



3



4



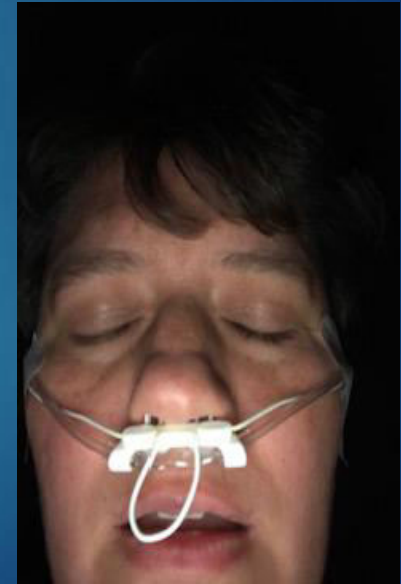
5



6

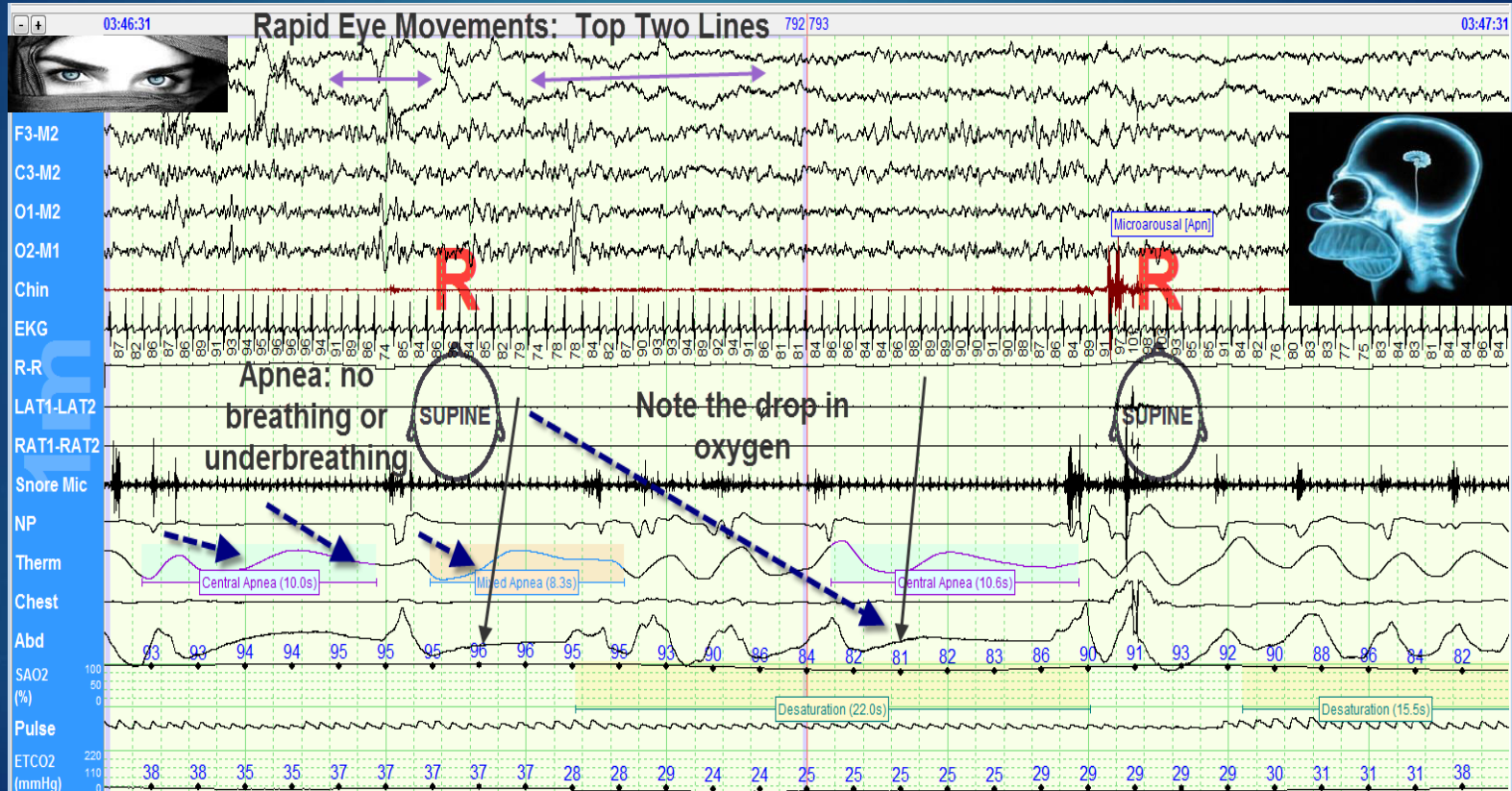
HOME SLEEP APNEA TEST

20% INACCURACY
20% FAILURE RATE



Walia et al., J Okla Med Assoc 2014

In Lab Study to Diagnose Sleep Apnea

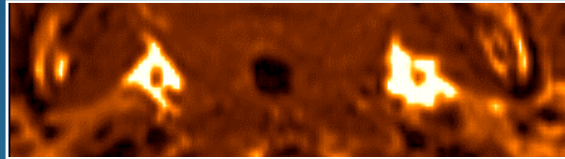


TREATMENT: COLIN SULLIVAN AND CPAP

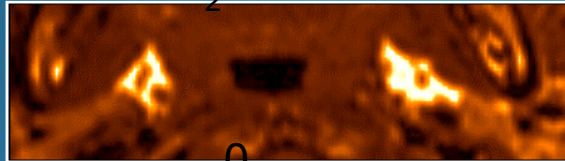


Lancet April 1981

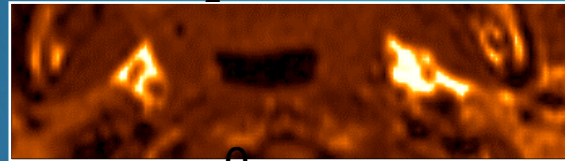
PAP Stents the Upper Airway



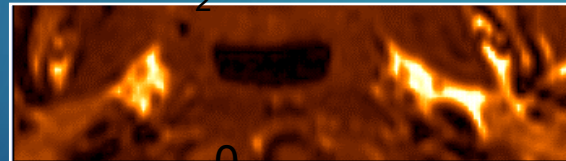
0 cm H₂O



5 cm H₂O



10 cm H₂O

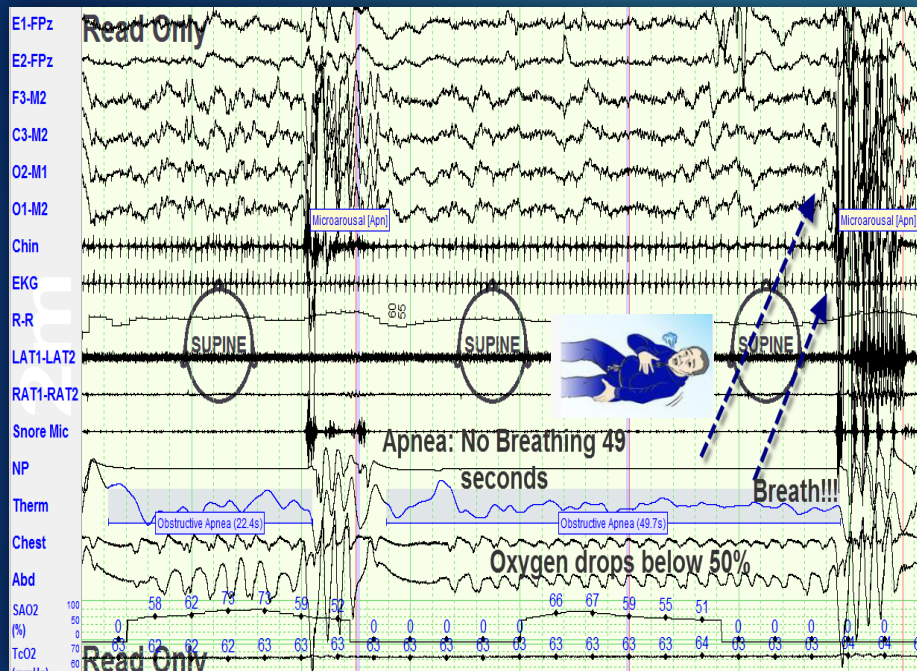


15 cm H₂O

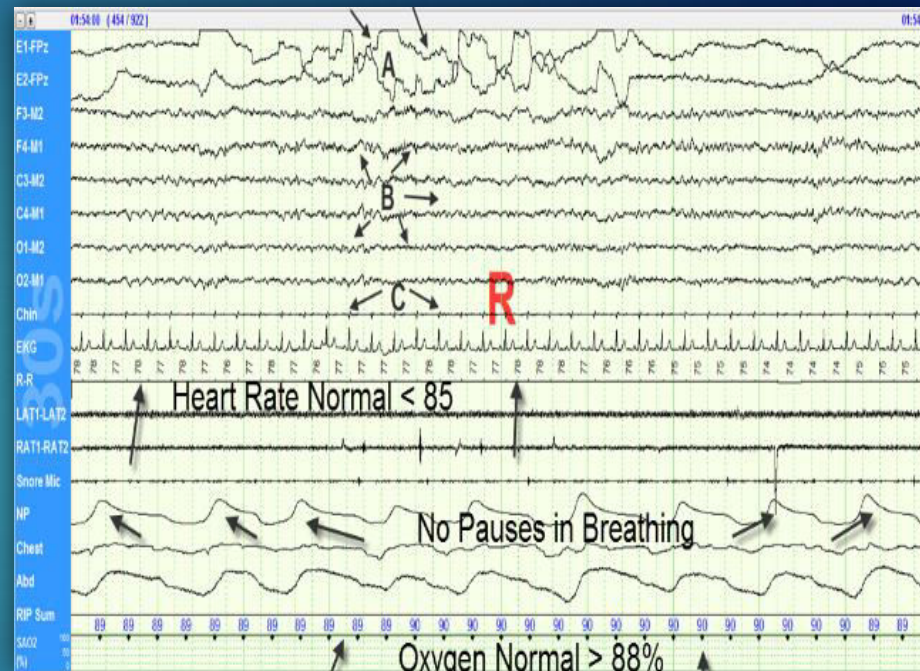
Coronal MRI cuts of upper airway

REFs: 1) Kuna et al. Am Rev Resp Dis 1988;138:969-75;
2) Schwab et al. Am J Respir Crit Care Med 1996;154:1106-16.

OSA without CPAP



With CPAP



Effectiveness of CPAP Therapy

- ▶ Decreases sleepiness
- ▶ Improves quality of life
- ▶ Improves cognitive function
- ▶ Decreases car accidents
- ▶ Improves glucose control
- ▶ Lowers blood pressure
- ▶ Reduces cardiac risk
- ▶ Reduces mortality rate
- ▶ Reverses impotence
- ▶ Decreases hospitalizations and health care costs

At least one peer-reviewed paper in literature to support the beneficial effect of CPAP in reversing or improving all of these adverse outcomes of OSA.



- ▶ However, CPAP will not cure male baldness.

Obstructive Sleep Apnea (OSA)

Objectives

- Various treatment options for OSA
- “Rise of the Machines”



CPAP: constant pressure

Bilevel PAP: higher pressure during inspiration (IPAP), lower during expiration (EPAP);

AutoPAP: (APAP) = CPAP or Auto bilevel PAP fluctuates

ASV: Points in time – central sleep apnea

When to Switch a Patient to Bilevel Positive Airway Pressure (BPAP) While Titrating PAP

- ▶ Appropriate to try BPAP if patient is:
 - ▶ Uncomfortable on CPAP;
 - ▶ Intolerant of high CPAP Pressures;
 - ▶ Continued obstructive respiratory events at 15 cm H₂O.



BPAP most useful for patients with neuromuscular disorders, sleep-related hypoventilation, but also for patients who have difficulty exhaling against high CPAP pressures, aerophagia, or claustrophobia.

Nasal Pillows



Nasal pillows often
good for those who"
don't like much on their
face"



Aeimed Head
Rest with nasal
seal



Puritan-Bennett Breeze



Fischer-Paykel Opus
360



Respironics OptiLife

Full Face Masks



ResMed Ultra
Mirage full face
mask



Innomed Hybrid
(nasal pillows
and mouth cover)



Fischer-Paykel Flexi-
Fit 4 full face mask



ResMed Quattro Pro
full face mask

Chin Strap: To Do or Not to Do?



Less efficient at eliminating mouth leak
than an oronasal (full face) mask.



Puritan-Bennett Chin Strap



ResMed Chin Restraint



Respironics Premium Chin Strap

CPAP Compliance

- ▶ Compliance
- ▶ 70% of time required for insurance to pay for supplies
- ▶ Minimum 4 hours/night over 30 days

REFs: 1) Am J Resp Crit Care Med 1994;150(6 Pt 1):1738-45; 2)
Kribbs NB et al. Am Rev Respir Dis 1993;147(4):887-95.

OTHER TREATMENT OPTIONS

- ▶ Dental appliances or mandibular advance devices;
- ▶ Surgery (Uvulopalatopharyngoplasty (UPPP), nasal and/or maxomandibular-surgeries; trachesotomy;
- ▶ Weight reduction or bariatric surgery;
- ▶ nasal dilators.

Options



Options

Mandibular Advancement Device

Mandibular Advancement Devices

*Most Effective Airway Orthotics
Some Examples...*



Dorsal



Narval



Tap



Silencer



Example of Orthotic in Mouth



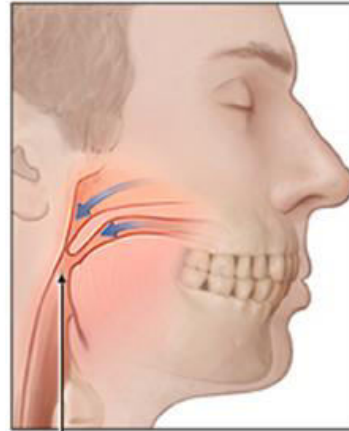
EMA



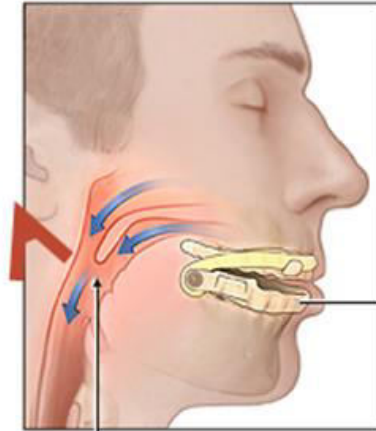
SUAD



Herbst



During sleep there is restricted airway space



Mandibular repositioning device (MRD) increases airway space

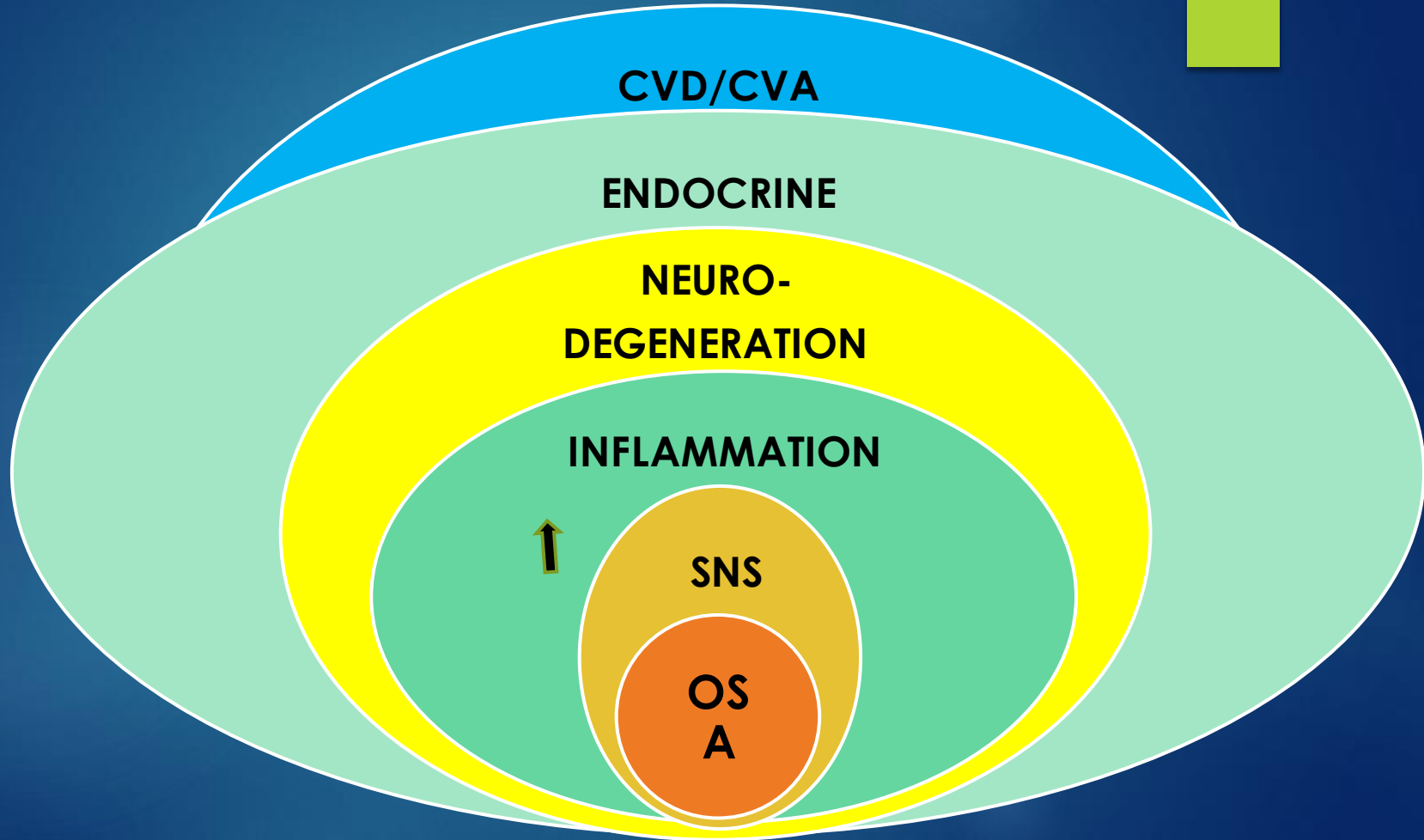
Option NEW DEVICE - INSPIRE



Continuous Positive Airway Pressure (CPAP)



CONCLUSION



QUESTIONS?



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505-252-9794